5. *Contributions to the Crustacean Fauna of South Africa.*—By K. H. Barnard, M.A., D.Sc., F.L.S., Assistant Director.

No. 10. A Revision of the South African Branchiopoda (Phyllopoda).

(With 33 Text-figures.)

Introduction.

Latreille's division of the Crustacea into the *Malacostraca* and the *Entomostraca* persists even at the present day, though it is recognised that the latter " constitute a very heterogeneous group, defined only by negative characters and having no claim to retention in a natural system of classification " (Calman, 1909).

The term Entomostraca, however, is frequently employed, in a general and colloquial manner, to denote the more lowly Crustacea, such as the Water-fleas (*Cladocera*), Cyclops (*Copepoda*), the Ostracods, the Barnacles (*Cirripedia*), and the group here dealt with—the Branchiopods or Phyllopods.

Using the term in this sense, but excluding the Barnacles, it may be said that the Entomostraca are an important constituent of the fresh-water fauna of South Africa. They are found in streams, lakes, vleis, dams, wells, either permanent or temporary. These Crustacea lay " resting-eggs," which are able to withstand desiccation for considerable periods ; when the vleis and dams dry up, these eggs, either in mud adhering to the feet of various aquatic birds, or in the dust blown about by the wind, can be carried far and wide over the country. When the rains fall, the eggs hatch.

It is possible, therefore, to collect these animals not only in the adult stage direct from ponds and dams, etc., but in the egg stage during the dry season. Samples of mud from the bottom and margins of dried-up pools are taken and placed in small glass jars with water, and when the Crustacea hatch they may be preserved and examined in all stages of development.

This is an extremely valuable method of collecting, and no oppor-

tunity of collecting samples of mud should be neglected. By this means many species have been added to the fauna-list, not only of this country but of others, *e.g.* Australia.

The samples should be taken from the surface layer, an eighth or a quarter of an inch thick ; it is useless to dig deeper into the mud. The best part of the pool from which to take the mud is the extreme

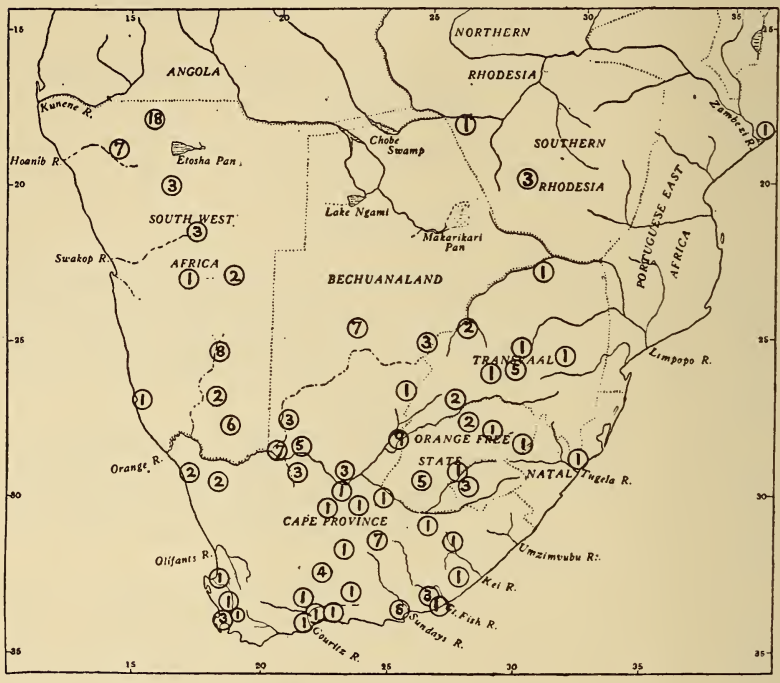

Fig. 1.—Locality map, showing actual number of species recorded in the present work.

centre where the water has remained longest, or from around the margins where a water-level mark occurs composed of the debris of bits of stick, leaves, etc., and the dried bodies or shells of the animals themselves. Spencer and Hall (1896, Horn Sci. Exp. Centr. Austr., ii, Zool., p. 229) have noted that *Apus* seems to congregate at the shallower edges of the pool as the water dries up, where the animals bury themselves just below the surface of the mud.

The late G. O. Sars in a series of papers (Ann. S. Afr. Mus., xv, 4, 1916 ; xx, 2 and 3, 1924 ; xxv, 1, 1927) has revised three groups of the Entomostraca, namely, the *Cladocera*, *Ostracoda*, and *Copepoda*,

for the most part, however, dealing only with the fauna of the Cape Province. As a basis for identifying and studying the fauna of the rest of South Africa these papers are very valuable.

The following account of the fourth group—the Branchiopoda or Phyllopoda—is based on what appears to be a considerable amount of material from many localities. But when the localities are plotted on a map (fig. 1) it is seen how scattered they are, and how very inadequate our collections are at present for the purpose of giving anything approaching a thorough survey of the Branchiopodan fauna of South Africa. Many additional species will certainly be added to the fauna-list in the future, and the distribution of those already recorded remains to be worked out. Paradoxical as it seems, Ovamboland may be said to have been more intensively explored than any other single region, thanks to the Administration of South West Africa in aiding the South African Museum expeditions to that territory.

The fossil representatives found in this country have been included, because they lead (at least in the case of *Lepidurus*) to interesting inquiries as to changes of climate during past geological epochs.

Acknowledgments are due to the Directors and Curators of the other Museums in the Union and Rhodesia, who have placed all their material at my disposal; and also to Dr. Haughton of the Geological Survey; Mr. J. H. Power of Kimberley; Dr. Calman of the British Museum; and to Mr. R. Gurney, whose work on the Entomostraca is well known.

As regards a portion of the material collected by myself and my colleagues, I have to acknowledge herewith: (1) a grant from the Research Grant Board in 1920, which enabled me to visit Ovamboland early in 1921; (2) the financial and other assistance rendered by the Administration of South West Africa and its officials, particularly Dr. Fourie, Major Manning, and Lieut. Hahn, in carrying out the Zoological Survey of South West Africa (chiefly Northern Damaraland, Ovamboland, and the Kaokoveld) in the years 1920, 1923, 1925, 1926.

The localities quoted are those from which the South African Museum has material, except where otherwise stated. The Institutions where type material is preserved are quoted in most cases. A set, including cotypes of the author's species, is in the British Museum.

Distribution.

For reasons already stated no attempt is here made to draw conclusions from the recorded distributions of the (living) species, but

attention may be directed to one or two outstanding features of the distribution and composition of the Phyllopod fauna.

Following Daday, 11 families are recognised: 5 in the *Anostraca*, 1 in the *Notostraca*, and 5 in the *Conchostraca*. All these families are represented in our region with the exception of the Anostracan family

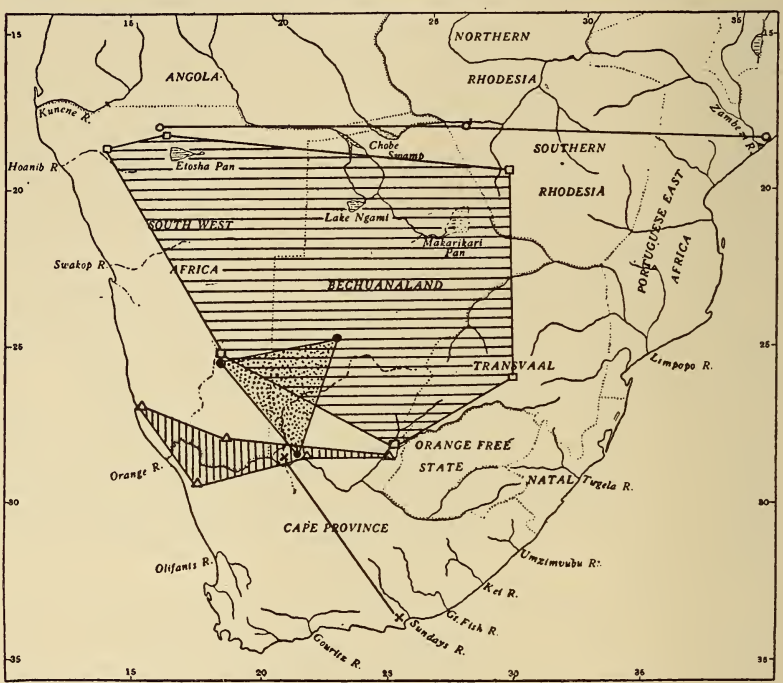

FIG. 2.—Distribution of: ○ *Cyclestheria*, □ *Eulimnadia africana*, △ *Apus namaquensis*, ● *Leptestheriella*, × *Artemia salina*. The recorded localities are merely linked up, without any implication that the species occurs everywhere within, and nowhere outside, the polygonal areas so formed.

Polyartemiidae, which hitherto has only been found in the Palaearctic region (with extensions to Alaska and the Pribiloff Islands). The other families are nearly world-wide in distribution, the apparent poverty of South America being probably due to lack of collecting.

As regards genera, 37 genera are known up to the present: * 22 Anostracan, 2 Notostracan, and 13 Conchostracan. Only 12 of these are represented in South Africa—5, 1, and 7 respectively. The

* Excluding *Bouvieria* Daday (see Intern. Catal., xiii, Crust., p. 40, 1914) and *Proterothriops* Ghigi.

Conchostracan element is therefore of a more cosmopolitan character than the Anostracan.

One genus (*Branchipodopsis*) is noteworthy in being almost exclusively South African (fig. 4). Eleven species are recorded, one of which has been reported also from British East Africa ; the twelfth species comes from Mongolia, thus constituting a rather remarkable case of discontinuous distribution.

Within the confines of the South African region scarcely any conclusions can be drawn as to distribution which might not be vitiated any day by the field collector, especially if he goes out with the special purpose of collecting these animals.

The genus *Leptestheriella* occurs in Southern Asia, Tropical Africa, and Madagascar, localities where apparently there is an abundant rainfall. Yet up to the present it has only been found in South Africa at three localities where the rainfall is distinctly low (fig. 2).

In the matter of species, 46 are recorded in the present paper.* Of these 26 are represented in the Cape Province, 18 in Ovamboland, 15 in Great Namaqualand, 14 in Transvaal, and 12 in Bechuanaland. Then follow in order — Kaokoveld (8), Damaraland (7), Orange Free State (6), Southern Rhodesia (4), Basutoland (3), Natal and Little Namaqualand (2 each), and Portuguese East Africa (1). The high (relative) abundance of species in Ovamboland and in the inaccessible and very little visited Kaokoveld is certainly due in part to the intensive collecting by the present writer and his colleagues. The same applies to Great Namaqualand and Bechuanaland, where members of the Museum staff and correspondents have been specially requested to collect these animals. Mr. J. H. Power of Kimberley has been especially assiduous in this matter ; also Mr. G. E. Hutchinson, formerly of the Witwatersrand University, Johannesburg.

The comparative poverty of the Orange Free State and Natal is striking, and, in view of the greater accessibility of these areas, raises a doubt as to whether this poverty is really due to lack of collecting, or whether it may not be due partly to a real poverty of species, caused by unfavourable or less favourable conditions of existence. It may be mentioned that the number of species recorded from the Transvaal has been raised from 5 to 14 by collecting in very few localities only.

On the map (fig. 1) are plotted the actual numbers of species recorded from the different localities in the present paper.

* Excluding the doubtful *Lynceus wahlbergi*.

Research.

Now that there are, in addition to the museums, several universities and university colleges teaching zoology in South Africa, it may be useful to indicate one or two lines on which research might be conducted.

In the first place, intensive collecting over the whole of South Africa is badly needed ; and if one area needs it more than another, then a glance at the locality-map (fig. 1) will show that Natal, Transvaal, Rhodesia, and Northern Bechuanaland are more likely to yield results than the other areas.

The sporadic appearance, both in time and space, of many Phyllopods is well known. A species may be found in one year in a certain locality and not in subsequent years. But it may make its appearance in a neighbouring locality where it was not previously known. Collecting, even in one locality, requires therefore to be carried on over a number of years if possible.

The environmental factors governing the appearance and distribution of these animals require to be studied. Daday (1910, Ann. Sci. Nat., ser. 9, vol. xi, p. 462) believed that there was an intimate relation between the habitats and the temperature, and gave a table of the Anostracan genera occurring within different isothermal lines. Temperature no doubt is a factor to be considered, but probably the distribution does not follow the isothermal lines quite so simply as Daday thought. The temperature at certain particular seasons of the year is probably a far more decisive factor than the mean yearly temperature.

Similarly, the isohyetal lines will not explain the distribution, for these ignore the seasonal character of the rainfall and the permanent or temporary character of the vleis and ponds.

Differences, if any, in the composition of the fauna of permanent and temporary ponds, etc., also require to be worked out, together with the salinity and chemical composition of the water.

The peculiar distribution of *Apus namaquensis* (fig. 2) requires an explanation. In South Africa it has been found in a few localities, from Angra Pequena (Lüderitzbucht) and Bushmanland eastwards to Kimberley, where it occurs along with *A. numidicus* ; it has been reported from one locality in British East Africa.

The distribution of *Branchipodopsis* (fig. 4) invites comparison with that of *Streptocephalus* (fig. 8) and *Apus* (fig. 24). Clearly none of these distributions can be explained in terms of simple isotherms and

isohyets. Local meteorological conditions should receive close attention. It should be noted that in these maps the recorded localities are merely linked up, without any implication that the species occurs everywhere within, and nowhere outside, the polygonal areas so formed.

On the question of the hatching of the resting eggs, confirmation of Brauer's results (see *infra*, p. 227) is much desired. Experiments to determine to what extent desiccation of the ova is necessary to ensure their development could be easily instituted, and should be undertaken not only for *Apus* but for as many as possible of the South African Phyllopods.

The one exception to the production of resting eggs, namely, the viviparous *Cyclestheria*, seems to be confined to permanent water-holes and pools, as one would expect to be the case. Two of the localities in Ovamboland where the present writer found this form were water-holes belonging to populous native villages, which probably would not dry up during the dry season. Two other localities, however, appeared to be only temporary vleis. It would be interesting to determine, therefore, whether *Cyclestheria* is able to retain vitality while buried in the mud during the dry season, and to breed when released at the next wet season, in a similar manner to *Cryptocyclops inopinatus* (see Sars, Ann. S. Afr. Mus., xxv, p. 136, 1927).

BRANCHIOPODA.

Calman (1909, Lankester's Treat. Zool., vii, 3, Crust., pp. 52, 53) makes the *Branchiopoda* a subclass of the *Crustacea*, with four orders : *Anostraca*, *Notostraca*, *Conchostraca*, and *Cladocera*. Gurney, Brady, Methuen, and especially G. O. Sars, have dealt with the South African *Cladocera*. The other three orders are dealt with here.

Body usually elongate, uniformly segmented ; without a carapace, or with a carapace which may form a dorsal shield or a bivalve shell ; usually ending in a caudal furca. Compound eyes present, usually close together ; the single nauplius eye or ocellus usually persisting in adult. Antennules generally reduced and unsegmented. Trunk-limbs varying greatly in number, usually foliaceous, rarely pediform.

Development usually by metamorphosis, the young passing through a free-swimming nauplius or metanauplius stage.

With the exception of a very few marine *Cladocera*, the whole subclass is non-marine, living in fresh water, though some are found in brackish water and saline marshes.

Order 1. ANOSTRACA.

1867.	*Anostraca.*	Sars, Crust. d'eau douce Norv., pp. 5, 6.
1902.	*Gymnophylla.*	Stebbing, Encycl. Brit., ed. 10, vol. xxviii (Suppl., vol. iv), p. 269.
1910.	*Anostraca.*	Daday, Ann. Sci. Nat., ser. 9, vol. xi, p. 91 (monograph), and *ibid.*, xii, p. 241 (appendix).
1913.	,,	*Id.*, *ibid.*, ser. 9, vol. xvii, p. 207 (appendix).

Body elongate, without carapace, ending posteriorly in a caudal furca. Posterior segments without legs (apodous). Paired compound eyes pedunculate; a small median sessile ocellus in front. First antennae short, slender. Second antennae large and prehensile in ♂, reduced in ♀. Trunk-limbs (legs), 11–19 pairs; none postgenital. Rami of the caudal furca unsegmented. Genital ducts opening on the first two apodous segments, which are more or less fused. Paired eversible penes in ♂. Ova retained in an ovisac formed of the united oviducts. Young hatched in the Metanauplius stage.

Distribution world-wide. Some species living in salt lakes and saline marshes.

Throughout this order *specific* differences in the females are very slight, and the classification is based mainly on the male characters. Consequently isolated female specimens can usually be placed only in their respective families. The elongate abdomen without (usually, or with reduced) caudal furca will at once distinguish *Artemia*; a short, more or less globular ovisac will indicate a Branchipodid or a Chirocephalid, and an elongate ovisac a Streptocephalid. The second antenna is lanceolate in the Chirocephalids, oblong with an apical point in the Branchipodids. Identification of the various species within the families will be next to impossible, though in a few cases there are distinctive features.

In Stebbing's General Catalogue of South African Crustacea, 1910, only 6 species of this order are listed. The present work records a total of 27 species.

Key to the South African families.

1. Second antennae in ♂ biarticulate.
   a. Head without frontal process.
      i. Bases of 2nd antennae ♂ not, or but slightly, connate, without processes . . . . . *Artemiidae.*

ii. Bases of 2nd antennae ♂ connate, forming a clypeus, with two processes of various shape . . . . *Branchipodidae.*

b. Head with frontal process. Bases of 2nd antennae ♂ separate *Chirocephalidae.*

2. Second antennae in ♂ triarticulate, cheliform . . . *Streptocephalidae.*

Fam. ARTEMIIDAE.

1896. *Artemiidae.* Grochowski, Verh. zool. bot. Ges. Wien., xlv, p. 99.

1910. *Branchinectidae.* Daday, Ann. Sci. Nat., xi, p. 111.

Eleven pedigerous segments. Eight or nine abdominal (apodous) segments. Head in ♂ without frontal process. Second antenna ♂ biarticulate, not, or only slightly, fused at base, without processes. Legs with a single branchial lamina. Rami of caudal furca variable, fused with last abdominal segment or freely movable. Ovisac subglobular or cylindrical.

Europe, Asia, North and South America, Australia, North and South Africa. In stagnant water, fresh or saline.

The family should take its name from the oldest genus; Daday was incorrect in forming a new family name.

Only one genus in South Africa.

Gen. Artemia Leach.

1819. *Artemia.* Leach, Dict. Sci. Nat., xiv, p. 543.

1910. ,, Daday, Ann. Sci. Nat., xi, p. 114.

Body slender, abdomen often exceeding the trunk in length. Eight abdominal segments, the last one often much longer than any of the others. Bases of 2nd antennae in ♂ slightly fused; inner margin with a wart-like knob; 2nd joint flattened, laminate, apically acute. Ovisac subglobular. Rami of caudal furca movable, or fused with last abdominal segment, or absent.

Two species are recognised: *salina*, with the last abdominal segment longer than the others, with a wide distribution; and *jelskii*, with the last abdominal segment not longer than the others, placed in the subgenus *Callaonella*, from South America. *A. salina* is an extraordinarily variable species, and the variations appear to depend, partly at least, on the degree of salinity of the water in which the animals live. They can live in both fresh water and saline water,

even of a high concentration, being found in the evaporation pans used in the manufacture of salt.

The old statement that *Artemia* when bred through successive generations in water of diminishing salinity developed the characters of an allied genus " Branchipus," and that the latter developed into *Artemia* if the salinity were increased, was due to a confusion of taxonomic characters. The old " Branchipus," *sensu lato*, contained several diverse species. The true *Branchipus*, as nowadays defined, belongs to the family *Branchipodidae*. Thus in the experiments which gave rise to the above statement there was no change from one genus to another, but merely a variation of characters which are now regarded as not even specific.

Artemia salina (Linn.).

(Text-fig. 3.)

1758. *Cancer salinus.* Linne, Syst. Nat., 10th ed., i, p. 634.

1910. *Artemia salina* and vars. Daday, Ann. Sci. Nat., xi, p. 117, figs. 4–7 (references and synonymy).

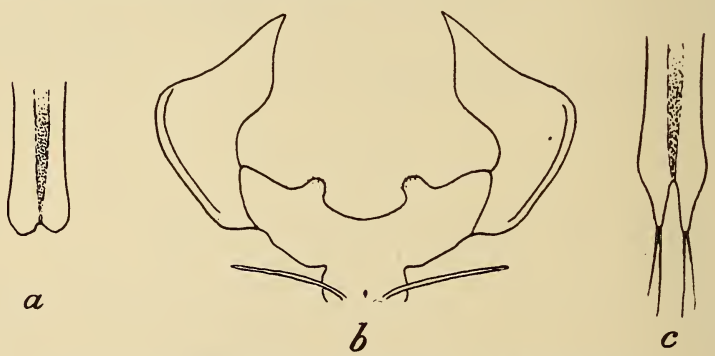

Fig. 3.—*a*, *b*, *Artemia salina* var. *köppeniana*, apex of abdomen and 2nd antennae of ♂. *c*, var. *milhausenii*, apex of abdomen.

var. *köppeniana* Fischer.

1851. *Artemia köppeniana.* Fischer in Middendorf, Reise Nord. u. Ost. Siberiens, ii, p. 157, pl. vii, figs. 29, 30, 36, 37.

1910. *Artemia salina* var. *köppeniana.* Daday, *loc. cit.*, p. 123, fig. 5*a*.

Last abdominal segment subtruncate or slightly bilobed. Caudal furca entirely absent.

Length.—Up to 8–9 mm.*

Colour.—Reddish, eyes dark.

Locality.—Cape Province : salt pans at Port Elizabeth and Zwartkops ; pans at Narugas and Kourop (Gordonia District).

Distribution.—(var. *köppeniana*) Southern Russia (Daday).

var. *milhausenii* (Fischer).

1834. *Branchipus milhausenii.* Fischer, Bull. Soc. Sci. Nat. Moscow, vii, p. 459, pl. xvi.

1910. *Artemia salina* var. *milhausenii.* Daday, *loc. cit.*, p. 126, figs. 4*e*, 5*b–l*.

Last abdominal segment produced in two more or less divergent digitiform processes, representing the caudal furca, each tipped with 1–3 setae.

Length.—8–10 mm.

Colour.—(As preserved) whitish, eyes dark.

Locality.—Cape Province : Port Elizabeth (N.E. Prince Alfred Lake) (Albany Museum).

Distribution.—(var. *milhausenii*) Crimea, Transcaspia, Kirgiz, Persia (Daday).

Up to the present this species has been found in only two localities in South Africa. Daday (1910, p. 121) remarked on the apparent absence in South Africa of this nearly cosmopolitan species.

Only a few specimens are in the South African Museum : the first lot were collected in December 1909 and January 1910 by J. L. Drege, who was instrumental in bringing to light several other forms of Entomostraca in the neighbourhood of Port Elizabeth. Specimens were sent by the late Dr. Purcell in 1910 to the late G. O. Sars, but it seems that the latter never had occasion to publish the record.

The second lot were collected by myself in the Gordonia District. They were not collected alive, but picked out of dried mud, and consequently are in a poor and fragmentary condition. They can be identified as *A. salina*, and may belong to var. *milhausenii*, though one specimen seems to indicate that they may be var. *principalis* Simon, with well-developed movable caudal furca. Attempts to breed specimens from the dried mud have hitherto proved unsuccessful.

The specimens in the Albany Museum, assigned to var. *milhausenii*, were also collected by J. L. Drege.

* Throughout the Anostraca the length given does not include the caudal furca, except where specially stated.

Fam. BRANCHIPODIDAE.

1910. *Branchipodidae.* Daday, Ann. Sci. Nat., xi, p. 287.

Eleven pedigerous segments. Eight or nine abdominal (apodous) segments. Front part of head in ♂ fused with the basal joints of the 2nd antennae to form a clypeus; with paired processes, or a single median process, or without any process. Second antennae in ♂ biarticulate, fused at base. Legs with a single branchial lamina. Rami of caudal furca either fused with last abdominal segment or free. Ovisac short, subglobular.

Europe, Asia, Africa, Australia. In stagnant fresh water.

Only one genus in South Africa.

Gen. Branchipodopsis Sars.

1898. *Branchipodopsis.* Sars, Arch. Naturv. Krist., xx, 4, p. 26.
1900. ,, Thiele, Zool. Jahrb. syst., xiii, p. 563.
1910. ,, Daday, Ann. Sci. Nat., xi, p. 293, and xii, p. 259.

Nine abdominal segments, the last shorter than the others. Rami of caudal furca falciform, not fused with last abdominal segment. No process arising from vertex of head in ♂, but a small median ventral process between the fused bases of 2nd antennae (sometimes obsolete). Basal joint of 2nd antenna in ♂ with a conical, subconical, or digitiform process on inner anterior side, and a small setiferous lamelliform process near the distal end; 2nd joint uncinate, curved inwards, often contorted, unarmed.

Southern Africa and East Africa; one species in Mongolia.

So far as is yet known the genus occurs in all the geographical provinces, which are here adopted, except Rhodesia and Portuguese East Africa. I have seen specimens from Rietfontein in the Transvaal (Coll. G. E. Hutchinson), but, as they were all females, specific identification was not possible.

This genus is easily recognised by the relatively enormous and strongly chitinised clypeus.

FIG. 4.—Recorded localities of the genus *Branchipodopsis* in South Africa. (See legend to fig. 2.)

Key to the South African species (males).

I. Last abdominal segment without ventral spines.

A. A median ventral process between bases of 2nd antennae. 2nd joint of 2nd antenna falciform.

1. Basal process of 2nd antenna conical on a broad base . . *hodgsoni.*
2. Basal process cylindrical.
   a. Apex of basal process with one point . . . *kalaharensis.*
   b. Apex of basal process with three points . . *natalensis.*

B. No median ventral process. 2nd joint geniculate . . *simplex.*

II. Last abdominal segment with 2 spines on ventral surface.

A. Median ventral process ovate. 2nd joint of 2nd antenna falciform, or gently curved.

1. Basal process of 2nd antenna with a strong spiniform projection at its base . . . . . *tridens.*
2. Basal process without a basal projection.
   a. Basal process apically trituberculate . . *wolfi.*
   b. Basal process narrow, bilobed . . . . *browni.*

c. Basal process broad, trilobed . . . . *karroensis.*
d. Basal process slender, spiniform . . . *scambus.*
B. Median ventral process truncate. 2nd joint arcuate . *drepane.*
C. Median ventral process obsolete. 2nd joint stout, evenly curved *kaokoensis.*

Branchipodopsis hodgsoni Sars.

(Text-fig. 5, *k*, *l*.)

1898. *Branchipodopsis hodgsoni.* Sars, Arch. Naturv. Krist., xx, 4, p. 26, pl. iii.
1910. ,, ,, Daday, Ann. Sci. Nat., xi, p. 301, fig. 51.
1921. ,, *braueri.* Wolf MSS., Pesta, Ann. Naturh. Mus. Wien, xxxiv, p. 94 (nom. nud.).

Last abdominal segment in ♂ without ventral spines. Basal process of 2nd antenna ♂ conical on a broad base, ending in two acute spiniform points; 2nd joint falciform, curved inwards and then forwards near the subtruncate apex. Median ventral process ovate.

Length.—Up to 14 mm.

Colour.—Pale yellowish or reddish, caudal furca in ♂ orange, ovisac with red, white, and blue stripes.

Locality.—Cape Province: Port Elizabeth; Ashton.

Type in South African Museum.

There is little doubt that the specimens in the Vienna Museum from Port Elizabeth, referred to by Pesta, belong to this species. Pesta gives the Vienna Museum acquisition number as "1898, xi, 3," indicating apparently that they were received at the Museum in 1898, *i.e.* in the same year as Sars published his description. Wolf's determination of them as a "n. sp." was probably made, either simultaneously or later, in ignorance of Sars' paper. If this is so, Pesta should not have allowed the name *braueri* to appear in print without at least showing that the specimens in question actually do differ from *hodgsoni*.

Branchipodopsis kalaharensis Daday.

(Text-fig. 5, *j*.)

1910. *Branchipodopsis kalaharensis.* Daday, Ann. Sci. Nat., xi, p. 296, fig. 49.

Last abdominal segment of ♂ without ventral spines. Basal process of 2nd antenna ♂ stout, apically rounded-subtruncate with a sub-

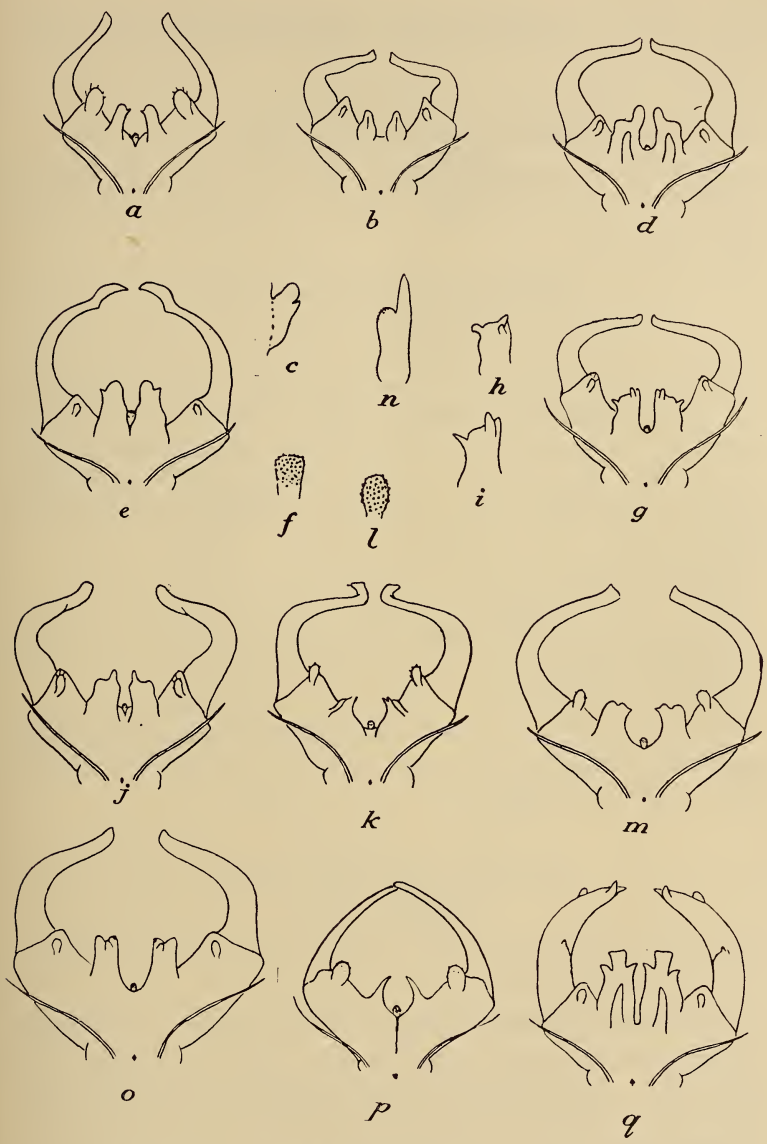

FIG. 5.—*Branchipodopsis*. Clypeus and 2nd antennae of ♂ of : *a*, *browni* ; *b*, *c*, *simplex*, with basal process in lateral view ; *d*, *tridens* ; *e*, *f*, *drepane*, with median process enlarged ; *g*, *h*, *i*, *wolfi*, with two variations of the basal process ; *j*, *kalaharensis* ; *k*, *l*, *hodgsoni*, with median process enlarged ; *m*, *n*, *karroensis*, with 2nd antenna of ♀ ; *o*, *natalensis* ; *p*, *scambus* ; *q*, *kaokoensis*. (*j* after Daday, others original.)

acute point on inner apical angle ; 2nd joint falciform, curved inwards and then forwards near apex. Median ventral process ovate.

Length.—11 mm.

Locality.—Bechuanaland : Kalahari (Daday).

Type in Senckenberg Museum, Frankfurt a/M.

This species is not represented in the South African Museum collections, or in any of the other museum collections in this country which I have seen.

Branchipodopsis natalensis n. sp.

(Text-fig. 5, *o.*)

Last abdominal segment in ♂ without ventral spines. Basal process of 2nd antenna in ♂ apically bilobed, the lobes subequal, the inner with a minute apical conical tubercle, a coniform lobe on upper side near base of inner lobe ; oval flap near apex of 1st joint small ; 2nd joint falciform, apex subtruncate. Median ventral process narrow-ovate.

Length.—5 mm.

Colour.—Not recorded.

Locality.—Orange Free State : van Reenen (border of Orange Free State and Natal).

Type in Natal Museum.

I have seen only one ♂ and two ovigerous ♀♀ of this form. In the absence of transitional forms it is not possible to regard it as a variety of any of the other species.

Branchipodopsis simplex Brnrd.

(Text-fig. 5, *b, c.*)

1924. *Branchipodopsis simplex.* Barnard, Ann. S. Afr. Mus., xx, p. 217, pl. xxvi, figs. 2, 3.

Last abdominal segment in ♂ without ventral spines. Basal process of 2nd antenna ♂ conical, dorsally keeled, with a subterminal notch in the keel ; 2nd joint strongly and angularly bent inwards, apex subtruncate. Median ventral process obsolete.

Length.—8 mm.

Colour.—Translucent, ovisac cobalt blue.

Locality.—Ovamboland : Eunda (about 100 miles W.N.W. of Ondongua).

Type in South African Museum.

Branchipodopsis tridens Daday.

(Text-fig. 5, *d.*)

1910. *Branchipodopsis tridens.* Daday, Ann. Sci. Nat., xi, p. 308, fig. 53.
1924. ,, ,, Barnard, Ann. S. Afr. Mus., xx. p. 217.

Last abdominal segment in ♂ with two spines on ventral surface near bases of caudal rami. Basal process of 2nd antenna ♂ conical, apically bilobed, the inner lobe more prominent, subacute, a strong conical spiniform projection arising from base of process; 2nd joint falciform, bent inwards, apex truncate and slightly bifid. Median ventral process ovate, but small and sometimes obsolete.

Length.—Up to 14 mm.

Colour.—Translucent.

Locality.—Cape Province: Papkuil, near Kimberley (Kimberley Mus.); between Upington and Keimoes; Narugas Siding; Bak River (all in the Gordonia District).
Bechuanaland: Kalahari (Daday).
Great Namaqualand: Great Fish River, near Gibeon.
Damaraland: Outjo and Cauas Okawa (Outjo District).
Kaokoveld: Kamanyab.

Type in Senckenberg Museum.

Branchipodopsis wolfi Daday.

(Text-fig. 5, *g, h, i.*)

1910. *Branchipodopsis wolfi.* Daday, Ann. Sci. Nat., xi, p. 304, fig. 52.
1913. ,, ,, *Id.*, Voy, Alluaud Afr. Orient. Phyllop., p. 4.
1924. ,, ,, Barnard, Ann. S. Afr. Mus., xx, p. 217.

Last abdominal segment in ♂ with 2 ventral spines. Basal process of 2nd antenna ♂ truncate-conical, ending in 3 blunt or acute tubercles, the one on outer lower margin projecting outwards; 2nd joint falciform, curving inwards, apex subtruncate. Median ventral process ovate.

Length.—Up to 15 mm.

Colour.—Translucent, ovisac cobalt blue.

Locality.—Basutoland : Morajia.
Cape Province : Kimberley (Kimberley Mus.).
Bechuanaland : Kalahari (Daday).
Little Namaqualand : Pofadder and T'abanoni.
Great Namaqualand : Great Fish River, near Gibeon.
Damaraland : Waterberg ; Outjo.
Ovamboland : Ongandjera (about 60 miles W. of Ondongua).
Kaokoveld : Kamanyab ; Choabendus.

Distribution.—Kinangop, British East Africa (Daday).

Type in Senckenberg Museum.

This seems to be the most widely spread species of the genus, and the only one which occurs both in Southern and Northern Africa.

There is considerable variation in the shape of the tubercles on the basal process of the 2nd antenna of ♂ ; sometimes the inner is acute and the outer blunt, sometimes *vice versa* ; or the upper tubercle may be very small.

Branchipodopsis browni Brnrd.

(Text-fig. 5, *a*.)

1924. *Branchipodopsis browni.* Barnard, Ann. S. Afr. Mus., xx, p. 217, pl. xxvi, fig. 4.

Last abdominal segment in ♂ with 2 ventral spines. Basal process of 2nd antenna ♂ bluntly conical, with a small acute point on the inner margin near apex ; oval flap near apex of 1st joint large and only feebly, if at all, setose ; 2nd joint falciform, but not strongly curving inwards, apex subtruncate. Median ventral process ovate.

Length.—10 mm.

Colour.—Translucent.

Locality.—Great Namaqualand : Kalkfontein South.

Type in South African Museum.

Branchipodopsis karroensis n. sp.

(Text-fig. 5, *m*, *n*.)

Last abdominal segment of ♂ with 2 ventral spines. Basal process of 2nd antenna ♂ flattened (dorso-ventrally), apically subtruncate with 2 small rounded lobes and an acute point projecting inwards ;

2nd joint falciform, curved inwards, apex subtruncate. Median ventral process ovate. Second antenna of ♀ with a long acute apical process, much greater than in any other species.

Length.—9 mm.

Colour.—Translucent.

Locality.—Cape Province : Hoogeveld, Beaufort West Division.

Type in South African Museum.

Branchipodopsis scambus n. sp.

(Text-fig. 5, *p.*)

Last abdominal segment of ♂ with 2 ventral spines. Basal process of 2nd antenna ♂ slender, spiniform, the points curving gently inwards ; oval flap near apex of 1st joint large ; 2nd joint slender, gently curved, apically subacute. Median ventral process ovate.

Length.—12 mm.

Colour.—(As preserved) yellowish.

Locality.—Cape Province : Grahamstown.

Type in Albany Museum, Grahamstown.

I have seen only a single ♂ of this form, which resembles *browni* in the large size of the oval flap on the 1st joint, but is well distinguished from all the other species by the shape of the 2nd joint of the 2nd antenna.

Branchipodopsis drepane n. sp.

(Text-fig. 5, *e, f.*)

Last abdominal segment in ♂ with 2 ventral spines. Basal process of 2nd antenna ♂ somewhat flask-shaped, apically bilobed, the inner lobe longer and rounded, the outer acute ; oval flap near apex of 1st joint very small ; 2nd joint falciform, not strongly bent inwards, with a rather sharp kink near apex ; apex acute. Median ventral process obovate, slightly wider distally, apically truncate.

Length.—9 mm.

Colour.—Translucent.

Locality.—Great Namaqualand : Great Fish River, near Gibeon.

Type in South African Museum.

A very distinct species, both on account of the form of the 2nd antenna and the shape of the median ventral process. Two male specimens were found among a lot of *B. tridens* and *wolfi*.

Branchipodopsis kaokoensis n. sp.

(Text-fig. 5, *q*.)

Last abdominal segment in ♂ with 2 large ventral spines. Basal process of 2nd antenna ♂ trilobed, the inner and outer lobes acute, the median one larger, apically truncate, a strong conical spiniform projection arising from base of process; 2nd joint stout, curved, apex bifid, a small conical tubercle on upper (front) surface near middle, and a slightly larger blunt one on anterior margin near apex. Median ventral process obsolete.

Length.—13 mm.

Colour.—Translucent.

Locality.—Kaokoveld: Choabendus (about 115 miles N.W. of Outjo).

Type in South African Museum.

Of this remarkable species I took 1 male and 4 females from a water-hole along with numerous *Streptocephalus cafer*. Although clearly allied to *tridens* it is perfectly distinct. Among the many examples of *tridens*, including some taken on the same expedition at localities further south, which I have examined, I have not seen one with any hint of the development of tubercles on the 2nd joint of the 2nd antenna which might be regarded as a transition form. This joint is, moreover, rather differently shaped in the two species. The bifid apex is merely a stronger development of that found in *tridens*.

Fam. CHIROCEPHALIDAE.

1910. *Chirocephalidae.* Daday, Ann. Sci. Nat., xi, p. 175.

Eleven pedigerous segments. Nine abdominal (apodous) segments. Head in ♂ with or without frontal appendages. Second antennae in ♂ separate at base, biarticulate; both joints either unarmed or with processes of diverse shapes. Legs with one or two branchial laminae. Rami of caudal furca movably articulated with last abdominal segment (except in *Thamnocephalus*). Ovisac more or less flask-shaped.

World-wide, except South America. In stagnant water, fresh or brakish.

Key to the South African genera.

1. Second antenna of ♂ uniramous . . . . . *Branchinella.*
2. Second antenna of ♂ biramous . . . . . *Branchinellites.*

Gen. Branchinella Sayce.

1840. *Branchipus* (part). M. Edwards, Hist. Nat. Crust., iii, p. 367.
1902. *Branchinella*. Sayce, Pr. Roy. Soc. Vict., n. s., xv, p. 233.
1910. ,, Daday, Ann. Sci. Nat., xi, p. 259.

Head in ♂ with frontal appendage. Basal joint of 2nd antenna in ♂ without process, 2nd joint falciform, usually unarmed, rarely with a process at base. Legs with a single branchial lamina.

Europe, N. America, Australia, S. Africa.

Branchinella ornata Daday.

(Text-fig. 6.)

Branchinema ornata. Wolf, in lit.
1910. *Branchinella* ,, Daday, Ann. Sci. Nat., xi, p. 266, fig. 40.

The essentials of Daday's description are as follows :—

Frontal appendage in ♂ longer than 2nd antenna, bifurcate for about half its length, each branch with short digitiform processes. Basal joint of 2nd antenna ♂ with 2 short stout tubercles on inner side ; 2nd joint unarmed. Second antenna in ♀ ovate, apically acute. Penis produced, vermiform.

The larger Potchefstroom specimens are characterised thus :

Body smooth as in Daday's specimens. Frontal appendage in ♂ when fully extended nearly twice as long as 2nd antenna, bifurcate, each branch with several long processes, arranged mostly in pairs. Basal joint on 2nd antenna ♂ with a strong pointed tubercle on inner margin, the lower inner apical angle also somewhat produced, the upper inner apical angle produced in a large lamina ; 2nd joint unarmed. First and second abdominal segments ♂ produced downwards in a triangular pointed flap on either side forming the base of the penis. Second antenna ♀ broadly ovate, with minute apical point. Rami of caudal furca in both sexes short, straight, with plumose setae on both margins. Ovisac considerably larger than in Daday's figure.

Length.—♂ and ovigerous ♀, 17 mm. (Daday : 11–12 mm., including caudal furca.)

Colour.—(As preserved) white, ova pinkish brown.

Locality.—Bechuanaland : Kalahari (Daday).
Transvaal : Potchefstroom.

Type in Senckenberg Museum; plesiotype, fully developed, in South African Museum.

The Kalahari specimens were considerably smaller than the Potchefstroom ones, and Daday himself thought that they were not fully

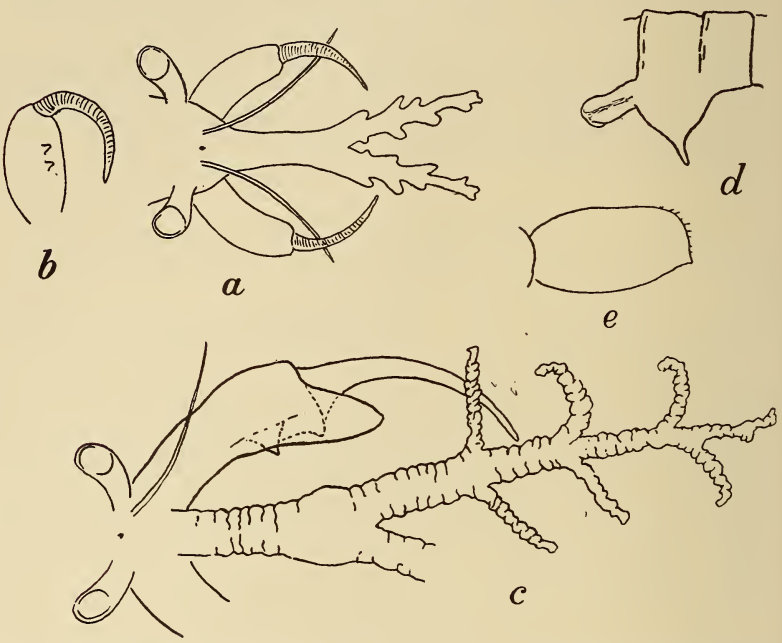

Fig. 6.—*Branchinella ornata* Daday. *a*, Head of ♂; *b*, internal lateral view of 2nd antenna of ♂; *c*, head, frontal process (right branch omitted), and left 2nd antenna of ♂; *d*, lateral view of right penis of ♂; *e*, 2nd antenna of ♀. (*a* and *b* after Daday; *c*, *d*, and *e* original, from the Potchefstroom specimens.)

grown. I think there can be no doubt that the Potchefstroom specimens represent the fully developed form of *ornata*. If, however, they prove eventually to be a separate species, the specific name might well be taken from the appearance of the frontal process when coiled up, resembling a Medusa head.

Gen. Branchinellites Daday.

1910. *Branchinellites.* Daday, Ann. Sci. Nat., xii, p. 254.
1924. ,, Barnard, Ann. S. Afr. Mus., xx, p. 215.

Head in ♂ with bifurcate frontal process, much longer than the 2nd antennae. Basal joint of 2nd antenna in ♂ with a papillose

process at distal end; 2nd joint falciform, without process. Legs with a single branchial lamina. Ovisac flask-shaped.

Japan, Middle Niger, South West Africa, Somaliland.

Branchinellites ondonguae Brnrd.

(Text-fig. 7.)

1924. *Branchinellites ondonguae.* Barnard, Ann. S. Afr. Mus., xx, p. 216, pl. xxvi, fig. 1.

1925. „ „ Masi, Ann. Mus. Civ. Genova, lii, p. 97, pl. iii.

Frontal process in ♂ very long, apically twice bifid; basal part with a proximal and a distal group of large spines on each infero-

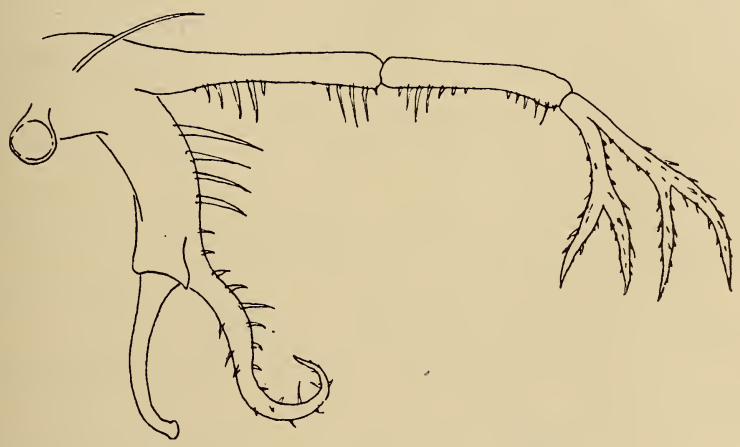

Fig. 7.—*Branchinellites ondonguae.* Head of male.

lateral margin; second part as far as 1st bifurcation rather shorter than basal part, armed on infero-lateral margins with spines of various sizes; apical part biramous, each ramus again bifurcate, armed with spines of various sizes, the lower ramulus simple (not cheliform). Second antenna in ♂ with large spines on anterior margin of 1st joint, anterior distal angle produced in a coiled process with spiniform papillae on its inner surface; 2nd joint curved, apically somewhat clavate. Second antenna in ♀ slender, apically acute.

Length.—Up to 27 mm.

Colour.—Semitransparent, ♂ whitish, ♀ greenish.

Locality.—Ovamboland : Ondongua and neighbourhood.

Distribution.—Italian Somaliland (Masi).

Type in South African Museum.

Masi has supplemented my description and figure with a good figure of the frontal process in ♂ and with figures of other parts of the animal. In the Somaliland specimens the inner ramulus of the frontal process is nearly twice as long as the outer, whereas in the Ovamboland specimens it is about equal to the outer one.

Fam. STREPTOCEPHALIDAE.

1910. *Streptocephalidae.* Daday, Ann. Sci. Nat., xi, p. 335.

Eleven pedigerous segments. Nine abdominal (apodous) segments, the last always shorter than the others. Head in ♂ simply rounded in front, or with a frontal process. Second antenna ♂ triarticulate, the distal joint cheliform. Legs with a single branchial lamina. Rami of caudal furca movably articulated with last abdominal segment. Ovisac cylindrical, usually elongate.

All continents except South America, but mainly in Africa. In stagnant fresh water.

This family contains only the one genus, remarkable for the form of the 2nd antenna in ♂ and the large number of species.

Daday has subdivided the genus into three subgenera :

1. *Streptocephalellus*, with the head in ♂ simply rounded in front or slightly notched, but no proper frontal process.

2. *Streptocephalus* sensu stricto, with a short, simple, frontal process, apically rounded or slightly bifid.

3. *Streptocephalopsis*, with a long, or very long, variously divided or branching frontal process.

This subdivision cannot be maintained. The distinction between the 2nd and 3rd subgenera is not very well defined, *S. rothschildi*, as Daday himself points out, being a transition form. *S. papillatus* is transitional between *purcelli* and *dregei* ; and *purcelli* really has a frontal process, albeit very short. Even with our present knowledge of the genus, there are species exhibiting every gradation between the two extreme forms—*purcelli* and *cladophorus*.

It is conceivable that forms, allied to *Streptocephalus* but differing sufficiently to justify generic separation, may be discovered in the future, and it seems a pity that Daday has used up such convenient names as those which he gave to his 1st and 3rd subgenera.

Gen. Streptocephalus Baird.

1852.	*Streptocephalus.*	Baird, Proc. Zool. Soc. London, p. 20.
1869.	*Heterobranchipus.*	Verrill, Amer. J. Sci. and Arts, ser. 2, xlviii, p. 250.
1898.	*Streptocephalus.*	Sars, Arch. Naturv. Krist., xx, p. 17.
1910.	,,	Daday, Ann. Sci. Nat., xi, p. 336.

With the characters of the family.

The 2nd antenna of the ♂ is stated to be three-jointed (Baird, Daday), but there appears to be no evidence of a true division into

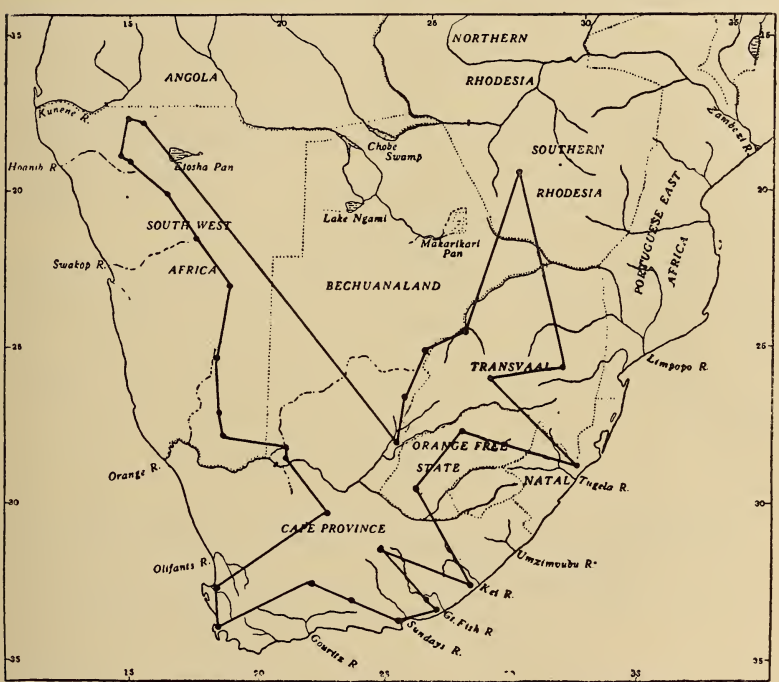

Fig. 8.—Recorded localities of the genus *Streptocephalus* in South Africa. (See legend to fig. 2.)

joints. A study of juvenile specimens, so far as the material has afforded opportunity, also discloses no satisfactory evidence. It would perhaps be more in keeping with the other families to regard this appendage of the *Streptocephalidae* as consisting only of two joints—the 1st comprising the whole of the appendage including the

" thumb " of the chela, the 2nd being the movable " finger." I have therefore avoided the use of the term " joint," as Sars has done.

Some of the growth changes which occur in *purcelli*, *cafer*, *ovamboensis*, and *proboscideus* are illustrated below.

In *purcelli* the finger seems to be immovable, or only slightly movable, though analogy with the other species, and the manner in which the finger there works against the thumb, would lead one to expect the chela to be functional also in *purcelli*. Freshly killed examples, which I have not had the opportunity of examining, would show whether the finger really is movable or not.

Without attaching for the present any particular significance thereto, the fact may perhaps be worthy of note that the species (*purcelli*), with a very feeble frontal process and a very simple " hand " on the 2nd antenna, features which may indicate either primitiveness or secondary simplification, appears to be found only in the extreme south-west of South Africa. On the other hand, those species in which these features are more developed and more complicated appear to be characteristic of more tropical regions. *S. torvicornis*, however, shows that this distinction must not be carried too far.

In many cases males with fully formed 2nd antenna are found with the penis shaped as in fig. 9, *g*. It is short and straight, with a small process projecting at right angles on the inner side. The fully formed and functional organ is considerably longer, more or less curved or coiled, with two rows of strong serrations on the margin (fig. 9, *f*).

Key to the South African species.

I. Frontal process in ♂ short or very short.
  A. Abdominal segments ♂ smooth. 2nd antenna ♂ without membranous processes or papillae.
    1. Frontal process rounded. Finger of chela of 2nd antenna ♂ slender.
      a. Last abdominal segment ♂ without lateral process. 2nd antenna ♀ oblong . . . . . *purcelli*.
      b. Last abdominal segment ♂ with lateral process. 2nd antenna ♀ broadly ovate . . . . . *dendyi*.
    2. Frontal process conical. Finger of 2nd antenna ♂ stout *kaokoensis*.
  B. Abdominal segments ♂ spinose. 2nd antenna ♂ with processes on middle portion and papillae on both finger and thumb . *papillatus*.
II. Frontal process ♂ moderate.
  A. A small process on inner side of base of 2nd antenna ♂.
    1. Finger of 2nd antenna ♂ flattened at base on anterior margin.
      a. Finger tapering, acute . . . . . *cafer*.
      b. Finger apically truncate . . . . . *dregei*.

2. Finger angular at base on anterior margin . . *cirratus.*

B. No process at base of 2nd antenna ♂.

1. Anterior and posterior prongs of thumb of 2nd antenna ♂ separated by one or two teeth.

a. One short triangular tooth . . . . *indistinctus.*

b. One narrow tooth . . . . . *ovamboensis.*

c. Two rounded teeth . . . . . *macrourus.*

2. Anterior and posterior prongs without any tooth between them; anterior prong long, posterior prong short. Finger with tooth on hind margin . . . . . *gracilis.*

III. Frontal process ♂ very long.

A. Frontal process with bifid apex . . . . . *proboscideus.*

B. Frontal process with lateral branch as well as bifid apex . *cladophorus.*

Streptocephalus purcelli Sars.

(Text-fig. 9.)

1898. *Streptocephalus purcelli.* Sars, Arch. Naturv. Krist., xx, 6, p. 4, pl. i.

1899. ,, ,, *Id., ibid.*, xxi, 4, p. 18, pl. ii, figs. 3–5.

1910. ,, ,, Stebbing, Ann. S. Afr. Mus., vi, p. 483.

1910. ,, ,, Daday, Ann. Sci. Nat., xi, p. 340, fig. 59.

1910. ,, ,, var. *sarsi*, *id.*, *ibid.*, p. 342, fig. 60.

♂. Abdominal segments smooth. Rami of caudal furca ensiform, basal half or third of inner margin with long plumose setae, outer margin and distal part of inner margin with simple spiniform setae rather widely spaced. Frontal process very short, broad, and deflexed, apically rounded or minutely notched. Second antenna comparatively short. 1st and 2nd parts setulose, appendix as long as, or longer than, 1st part, tapering to an acute apex; hand bifurcate, thumb elongate, curved, tapering to a fine point, with a more or less prominent digitiform tooth at its base on outer hind margin; finger elongate, curved, apically subacute, apparently only slightly or not at all movable.

Juv. ♂. In specimens about 4 mm. long 2nd antenna is a short unjointed appendage, apically bifid (fig. 9, *b*). In specimens 6 mm. long the appendix is present, and the distal portion is approaching the cheliform shape of the adult, but no trace of a division into joints can be discerned (fig. 9, *c*). The rami of the caudal furca are similar to those of the ♀.

♀. Second antenna oblong or oblong-ovate, with an acute apical point. Rami of caudal furca with long plumose setae on both margins. Ovisac long.

Length.—11–25 mm.

Colour.—Translucent.

Locality.—Cape Province: Green Point Common, Cape Town; Stompneus, St. Helena Bay; Stellenbosch.

Type in South African Museum.

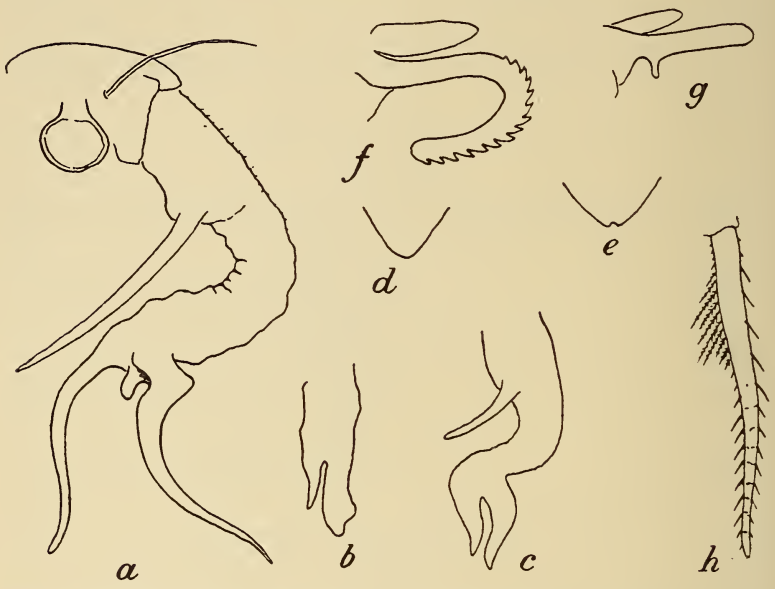

Fig. 9.—*Streptocephalus purcelli* Sars. *a*, Head and left 2nd antenna of adult ♂ (2nd antenna of right side removed); *b*, *c*, similar views of left 2nd antennae of juv. ♂ of 4 mm. and 6 mm. respectively; *d*, *e*, frontal process; *f*, *g*, penis of adult and juv. ♂ respectively; *h*, right ramus of caudal furca of adult ♂.

The ♂ specimen figured by Sars (1899), and regarded by Daday as a distinct variety (var. *sarsi*), appears to be merely an abnormality. The short claw-like process, with its secondary tooth, which takes the place of the usual elongate process, is not correlated with an elongate caudal furca; the latter occurs frequently, in fact more frequently in fully adult typical males than does the rather short form first described by Sars.

This aberration was found in the type locality, Green Point Common, and not at Port Elizabeth as stated in Daday's Monograph.

One other aberration has come to my notice. One of the ♂♂ from

Stompneus has a short conical process on the outside of one of the caudal rami just before the middle.

The Green Point locality has now been converted into a sports ground, and the species no longer occurs there. Nor has it been found in any of the numerous vleis and pans on the Cape Flats.

The Stompneus specimens were raised in the Museum from dried mud.

Streptocephalus dendyi n. sp.

(Text-fig. 10.)

Similar to *purcelli*, but: the small tooth between the thumb and finger of 2nd antenna ♂ obsolete; last abdominal segment ♂ with a

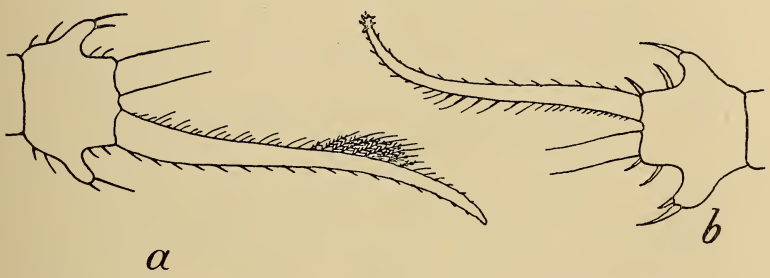

Fig. 10.—*Streptocephalus dendyi* n. sp., last abdominal segment and ramus of caudal furca of ♂: *a*, Cape Town form; *b*, Port Elizabeth form.

lateral setiferous or spiniferous process projecting horizontally and curved backwards; 2nd antenna ♀ obovate, only half as long again as broad, with a minute outwardly curved point in middle of distal margin; rami of caudal furca ♂ with plumose setae only on middle third of inner margin.

Length.—16 mm.

Colour.—Translucent.

Locality.—Cape Province: Rondebosch Camp Ground, Cape Town (S. Afr. Mus.); Thornhill, near Port Elizabeth (Albany Mus.).

Type in the South African Museum.

Collected by the late Professor A. Dendy in 1903. The Port Elizabeth specimens agree with the Cape ones, but the abdominal processes bear spines instead of setae, and the plumose setae are entirely absent on the inner margin of the rami of the caudal furca; the apex of the ramus bears a little cluster of spinules.

Streptocephalus kaokoensis n. sp.

(Text-fig. 11.)

♂. Abdominal segments smooth. Rami of caudal furca stout, straight, both margins with long plumose setae. Frontal process short, deflexed, sharply conical. Second antenna rather short, appendix apically subacute, thumb not spoon-shaped at base, bifurcate, anterior prong long, geniculate, tapering to a fine point, posterior prong about half length of anterior, broad at base, narrowing

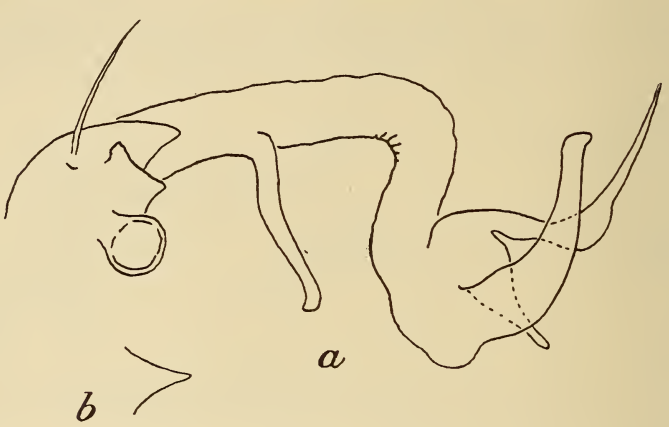

Fig. 11.—*Streptocephalus kaokoensis* n. sp. *a*, Head and left 2nd antenna of ♂ (right 2nd antenna removed); *b*, frontal process in dorsal view.

rather rapidly to a subacute apex, finger movable, stout, curved, apically subtruncate.

♀. Second antenna oblong-ovate, with small apical point. Rami of caudal furca as in ♂. Ovisac short, not extending beyond end of 4th abdominal segment.

Length.—5–6 mm.

Colour.—Translucent.

Locality.—Kaokoveld: N. of Kamanyab.

Type in South African Museum.

As regards the 2nd antenna ♂, this species resembles somewhat the East African *lamellifer* Th. and also *sudanicus* Daday, but the finger has no teeth or spinules on its anterior margin. The short ovisac distinguishes it from all the other South African species.

Streptocephalus papillatus Sars.

(Text-fig. 12.)

1905. *Streptocephalus papillatus.* Sars, Arch. Naturv. Krist., xxvii, 4, p. 4, pl. i.

1910. ,, ,, Stebbing, Ann. S. Afr. Mus., vi, p. 483.

1910. ,, ,, Daday, Ann. Sci. Nat., xi, p. 343, fig. 61.

1924. ,, ,, Barnard, Ann. S. Afr. Mus., xx, p. 218.

♂. Lateral margins of segments 3–7 with numerous small spines and denticles; segment 6 with a strong medio-dorsal recurved bifid

Fig. 12.—*Streptocephalus papillatus* Sars. *a*, Head and left 2nd antenna of adult ♂ (right 2nd antenna removed); *b*, frontal process; *c*, right ramus of caudal furca of adult ♂. (Beaufort West specimen, South African Museum.)

process; segment 7 with a similar but smaller non-bifid process; segment 5 also sometimes with a small medio-dorsal tooth. Rami of caudal furca stout, apically incurved; outer margin with long plumose setae passing into simple acute or digitiform spines apically; inner margin with plumose setae on basal half, followed by strong, apically hispid spines, which diminish in length towards apex. Frontal process short, deflexed, apically shallowly bifid (evidently overlooked by Sars). Second antenna elongate, appendix rather stout, incurved, apically blunt; 2nd part much longer than 1st, with a series of

numerous irregular spiniform or dentiform processes running from base on outer margin and passing over at the bend on to lower margin, where the series ends in 4–5 large teeth ; this part then expands and then contracts again before the hand ; hand with a basal lamina on each side which, when flexed, embraces the narrow distal portion of the 2nd part of the antenna, thumb elongate, triquetral in section, a strong acute tooth on its anterior basal margin, distally with a series of papillae on the sharp anterior edge, and numerous small tubercles on inner and outer edges of flat posterior surface, finger movable, elongate, with a strong bifid spiniform process on hind margin in basal third, distally triquetral in section, anterior flat surface with a median row of small tubercles, and a series of papillae on inner and outer edges, posterior sharp edge smooth.

♀. Second antenna oblong or oblong-ovate, with apical point. Rami of caudal furca with long plumose setae on both margins. Ovisac long.

Length.—17–22 mm.

Colour.—Translucent.

Locality.—Cape Province : Hanover (Sars) ; Hoogeveld, Beaufort West Division.

Great Namaqualand : Kalkfontein South.

Type ? in coll. G. O. Sars.

There are none of the original type specimens in the South African Museum. I have only seen specimens from the other two localities noted adove.

Streptocephalus cafer (Loven).

(Text-fig. 13.)

1847. *Branchipus cafer.* Loven, K. Vet. Ak. Handl., lxvi (for 1845), p. 433, pl. v, figs. 1–20.

1852. *Streptocephalus cafer.* Baird, Proc. Zool. Soc. Lond., p. 21.

1877. *Branchipus* (*Streptocephalus*) *caffer.* Brauer, SB. Ak. Wiss. Wien, lxxv, p. 605.

1910. *Streptocephalus cafer.* Stebbing, Ann. S. Afr. Mus., vi, p. 482.

1910. *Streptocephalus cafer.* Daday, Ann. Sci. Nat., xi, p. 392, fig. 79.

1913. *Streptocephalus propinquus.* Brady, Ann. Natal Mus., ii, p. 470, pl. xxxviii, figs. 2–6.

1924. *Streptocephalus cafer.* Barnard, Ann. S. Afr. Mus., xx, p. 220.

♂. Abdominal segments smooth. Rami of caudal furca nearly straight, both margins with long plumose setae, except the distal

third of inner margin which has about 8–10 strong upstanding spine-setae. Frontal process moderate, deflexed, apically bifid or trifid—if trifid the middle lobe shorter than the others. Second antenna moderate, a membranous flap with serrate lower margin on inner surface near base, appendix rather long, apically subacute; 2nd part with a rather large tooth-like process on inner surface near origin of appendix, followed by several smaller ones, lower margin at bend

Fig. 13.—*Streptocephalus cafer* (Loven). *a*, Head and left 2nd antenna of adult ♂ (right 2nd antenna removed); *b*, *c*, left 2nd antennae of juv. ♂♂ of 6 and 10 mm. respectively; *d–g*, frontal process showing variation, *g* a young specimen; *h*, right ramus of caudal furca of ♂.

with 1 large and 2–3 smaller tooth-like processes, thumb bifurcate, spoon-shaped at base, anterior margin not ending in a tooth, anterior prong long, geniculate, posterior prong short, both apically acute, a short triangular tooth between the two prongs, finger movable, long, geniculate, with a lobe-like tooth on about middle of anterior margin, margin proximal to the tooth flattened.

Juv. ♂. Frontal process bifid, the lobes short. In specimens about 6 mm. long 2nd antenna is short and apparently unjointed, finger and thumb short and simple (fig. 13, *b*); in specimens about 10 mm. long thumb is bifurcate, without the small tooth between the two prongs, finger slightly bent (fig. 13, *c*). Rami of caudal furca as in ♀.

♀. Second antenna oblong, with small apical point. Rami of caudal furca with long plumose setae on both margins, without any spine-setae. Ovisac long.

Length.—14–17 mm. (♂), 12–15 mm. (♀).

Colour.—Translucent.

Locality.—Cape Province : Kimberley (S. Afr. Mus. and Kimberley Mus.).

Bechuanaland : Lobatsi and Asbestos Mts. (J. H. Power).

Orange Free State : Bloemfontein (Daday).

Transvaal : " in paludibus terrae Caffrorum Natalensium " (Loven) (see note below) ; Wolmaranstad.

Zululand : Inkenjeni, near Mahlabatini (*S. propinquus* Brady).

Southern Rhodesia : Bulawayo (S. Afr. Mus. and Rhodesia Mus.).

Great Namaqualand : Great Fish River, near Gibeon.

Damaraland : Otjiwarongo ; Altmark and Otjikondo (Outjo District).

Kaokoveld : Choabendus.

Type in Stockholm Museum ; of *propinquus* in coll. Brady ?.

It seems likely that *propinquus* is a synonym of this species. Brady makes no mention of the frontal process or the appendage at base of the 2nd antenna. The figure of the 2nd antenna ♂ corresponds well with that of *cafer*, but shows a projecting tooth on the anterior margin of the anterior prong of the thumb similar to that in *indistinctus*. Brady considered his specimens were probably not adult ; the figure of the short ovisac, and the absence of a short tooth between the two prongs of the thumb in ♂, confirm this conclusion.

This is the most widely distributed species of the genus in South Africa. The locality given by Loven and quoted by Stebbing, " Natal, lat. 26½° S., long. 29° E., on the road from Port Natal to the salt pan of Makkalis Mt., between Crocodile and Ap rivers," obviously contains a contradiction. According to the latitude and longitude the locality would be in the Transvaal, to which also Makkalis Mt. (=Maghaliesberg) points ; though the latitude and longitude are again wrong for the Maghaliesberg between the Crocodile and Aapies rivers. But in either case Natal is excluded.

Streptocephalus dregei Sars.

(Text-fig. 14.)

1899.	*Streptocephalus dregei.*		Sars, Arch. Naturv. Krist., xxi, 4, p. 19, pl. ii, figs. 6–10 (♂).
1904.	,,	,,	Gurney, Proc. Zool. Soc., 1904, ii, p. 298, pl. xviii, figs. 1, 2 (♀).
1910.	,,	,,	Stebbing, Ann. S. Afr. Mus., vi, p. 483.
1910.	,,	,,	Daday, Ann. Sci. Nat., xi, p. 377, fig. 4.

♂. Abdominal segments 3–7 with several (up to about 8) small spines on hind margin—those on segments 3 and 4 laterally, those

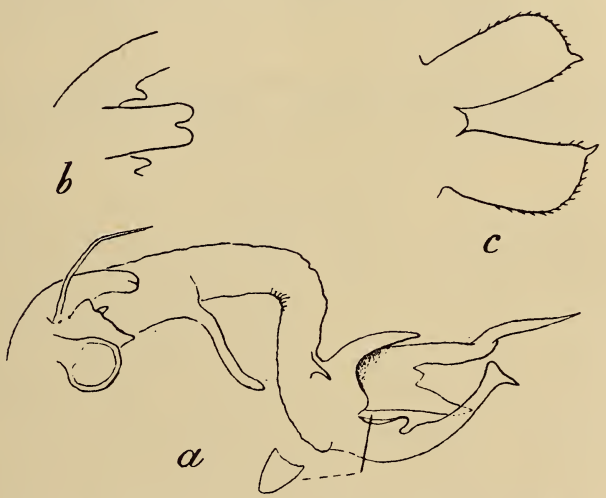

Fig. 14.—*Streptocephalus dregei* Sars. *a*, Head and left 2nd antenna of ♂ (right 2nd antenna removed); *b*, frontal process and base of 2nd antenna of ♂, showing appendage; *c*, 2nd antennae of ♀.

on segments 5–7 dorsally and dorso-laterally, and those on segments 5–7 more prominent than the others; spines obscure in immature specimens. Rami of caudal furca ensiform, outer margin with long plumose setae, inner with a small patch of plumose setae at base, followed by numerous close-set spiniform setae of varying length. Frontal process deflexed, about as long as head, apically bifid, sometimes " simple " or rounded, as stated by Sars and Daday. Second antenna moderate, a small and often obscure membranous appendage

on inner side at base, appendix incurved, apically subacute ; a tooth-like process on inner side near base of hand ; thumb bifurcate, spoon-shaped at base, anterior margin ending in a tooth, the anterior prong long, apically acute, with a bend or twist in middle ; posterior prong shorter, apically acute ; between them a short triangular tooth ; finger movable, curved, with a lobe-like tooth at base on anterior margin, proximal to which the margin is flattened ; apex truncate and expanded like a foot.

♀. Second antenna oblong, with apical point. Rami of caudal furca with long plumose setae on both margins. Ovisac long.

Length.—Up to 23 mm. (♂), 22 mm. (♀).

Colour.—Translucent, caudal furca red (Gurney).

Locality.—Cape Province : Port Elizabeth (Sars) ; Willowmore ; Blaauwkrantz, near Kowie Road; King Williams Town (Albany Mus. and Transvaal Mus.) ; Grahamstown (Albany Mus.).

Orange Free State : Kroonstad (Gurney).

Type ♂ in South African Museum, ♀ in British Museum.

Streptocephalus cirratus Daday.

(Text-fig. 15.)

1907. *Streptocephalus cirratus.* Daday, Ann. Sci. Nat., ser. 9, vii, p. 142, fig. 4.

1910. ,, ,, *Id., ibid.*, xi, p. 358, fig. 67.

Extremely close to *dregei.* ♂.—Spines present only on abdominal segments 5–7, more numerous and closely set. Rami of caudal furca with papilliform and less closely set processes along whole of inner margin from base to apex. Basal membranous appendage on 2nd antenna longer, apically bifid or entire, no tooth on inner side near base of hand, finger and both prongs of thumb shorter and stouter, finger with no tooth at base and anterior margin sharp ; sometimes a blunt tooth on anterior margin. ♀.—Second antenna ovate, apically incised, no apical point (Daday), or of the shape normal in the genus.

Length.—14–24 mm.

Locality.—Cape Province : Potfontein, N. of De Aar.

Orange Free State : Bloemfontein (Daday).

Transvaal : Rietfontein (between Johannesburg and Pretoria) ; Heidelberg.

Type in Paris Museum.

A large ♂ (24 mm.) from Potfontein is typical. I have seen females

tooth, anterior prong long, geniculate, tapering to an acute point, posterior prong shorter, apically acute, between them a short triangular tooth ; finger movable, long, geniculate, apically acute, with a slight notch followed by a lobe-like tooth on anterior margin, proximal to which margin is sharp.

♀. Second antenna oblong, with apical point. Rami of caudal furca as in ♂. Ovisac long.

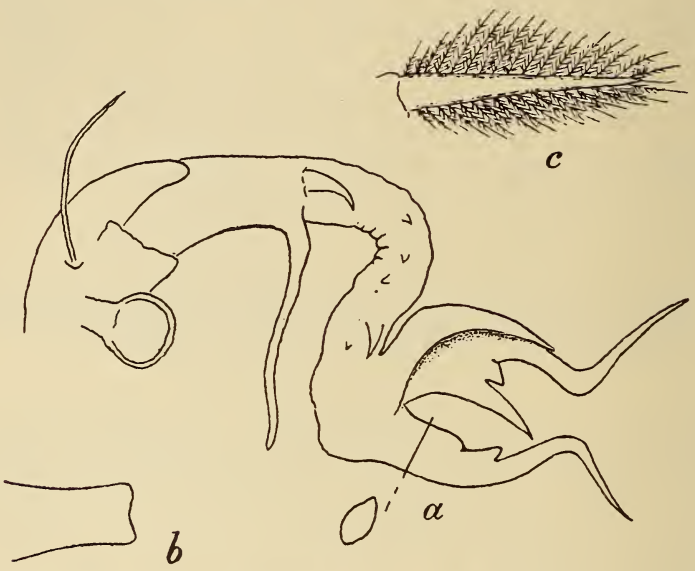

Fig. 16.—*Streptocephalus indistinctus* Brnrd. *a*, Head and left 2nd antenna of ♂ (right 2nd antenna removed); *b*, frontal process; *c*, right ramus of caudal furca.

Length.—18 mm. (♂), 14 mm. (♀).

Colour.—Translucent, more or less violet, caudal furca orange.

Locality.—Transvaal : junction of Marico and Crocodile rivers.
Great Namaqualand : Kalkfontein South.
Ovamboland : several localities (Barnard, 1924).

Type in South African Museum.

Closely allied to *distinctus* Th. from Madagascar, but differing in the rami of the caudal furca not having finely tapering apices set with spinules.

S. propinquus Brady may possibly be the same as this species and not a synonym of *cafer* ; but see under *cafer*.

Streptocephalus ovamboensis Brnrd.

(Text-fig. 17.)

1924. *Streptocephalus ovamboensis.* Barnard, Ann. S. Afr. Mus., xx, p. 220.

♂. Abdominal segments smooth. Rami of caudal furca stout, straight, both margins with long plumose setae, the setae not diminishing in length towards apex, but continuing of about the same length around the apex. Frontal process strong, deflexed, apically obtusely

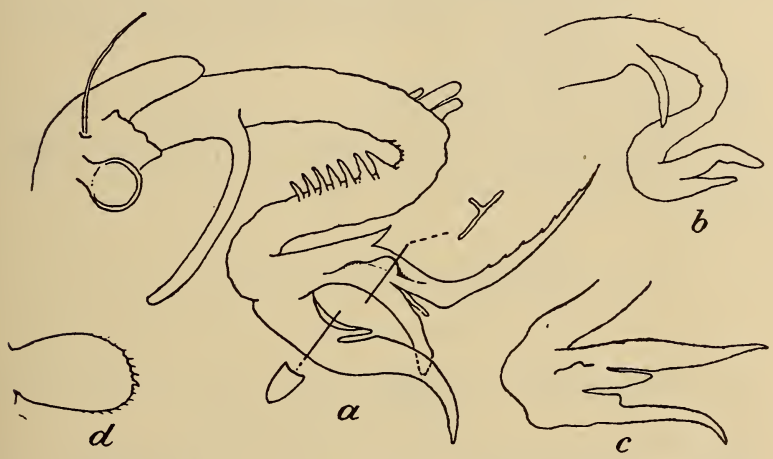

Fig. 17.—*Streptocephalus ovamboensis* Brnrd. *a*, Head and left 2nd antenna of adult ♂ (right 2nd antenna removed); *b*, *c*, left 2nd antennae of juv. ♂ of 10 mm. and 12 mm. respectively; *d*, left 2nd antenna of ♀.

rounded or truncate. Second antenna rather long, appendix long, apically subacute, middle part with several tooth-like processes on upper margin beyond the bend, and 2–3 large digitiform processes on anterior margin at the bend; thumb bifurcate, moderately broad at base, inner margin of spoon-shaped hollow ending in a rounded lobe projecting inwards at right angles, anterior margin with a tooth, anterior prong long, geniculate, tapering to an acute point, the upper margin serrate, posterior prong shorter, apically blunt, between the prongs a narrow digitiform process or tooth; finger movable, stout, arcuate, the acute apex curving posteriorly, a lobe-like tooth followed by a narrow notch on anterior margin, proximal to which the margin is flattened.

Juv. ♂. Specimens 10 mm. long have the hand simply bifurcate (fig. 17, *b*); specimens 12 mm. long have the anterior prong of the thumb bifid, the finger slightly curved, with incipient basal tooth (fig. 17, *c*).

♀. Second antenna broadly ovate, with apical point. Rami of caudal furca as in ♂. Ovisac long.

Length.—18 mm. (♂), 16 mm. (♀).

Colour.—♂ translucent, ♀ light brownish ; caudal furca bright orange, especially in ♀.

Locality.—Cape Province : Hanover ; Gordonia District.
Bechuanaland : Moloppo River (Kimberley Mus.).
Great Namaqualand : Keetmanshoop.
Ovamboland : Ukualonkathi (about 100 miles N.W. of Ondongua).

Type in South African Museum.

This species is closely allied to *torvicornis* Waga and its varieties, but is distinguished by the *narrow* process between the two prongs of the thumb and the form of the basal part of the finger of 2nd antenna (♂).

Streptocephalus macrourus Daday.

(Text-fig. 18.)

1907.	*Streptocephalus macrourus.*		Daday, Ann. Sci. Nat., vii, p. 143, fig. 5.
1910.	,,	,,	*Id., ibid.*, xi, p. 383, fig. 76.
1924.	,,	,,	Barnard, Ann. S. Afr. Mus., xx, p. 219.

♂. Abdominal segments smooth. Rami of caudal furca elongate, slender, outer margin with short plumose setae, basal half of inner margin with longer closely set plumose setae resembling a brush, distal half with rather widely spaced spine-setae of various lengths. Frontal process moderate, deflexed, apex subacutely pointed. Second antenna moderately long ; appendix long, slender, apically subacute, no processes on middle part of antenna ; thumb bifurcate, basally spoon-shaped, anterior margin ending in a long spine-like tooth, anterior prong long, geniculate, tapering to an acute point, posterior prong short, apically acute, between the two prongs two short rounded teeth ; finger movable, long, basally thickened, its anterior margin sharp, and ending in a lobe-like tooth, apex subacute or subtruncate.

♀. Rami of caudal furca shorter and stouter than in ♂, both margins

with long plumose setae. Second antenna oblong, with a minute, often obsolete, apical point. Ovisac long.

Length.—15–22 mm. (♂), 18–20 mm. (♀).

Colour.—Translucent; ♂ often pale sea-green, ♀ usually violet; caudal furca bright orange or red, especially in ♀.

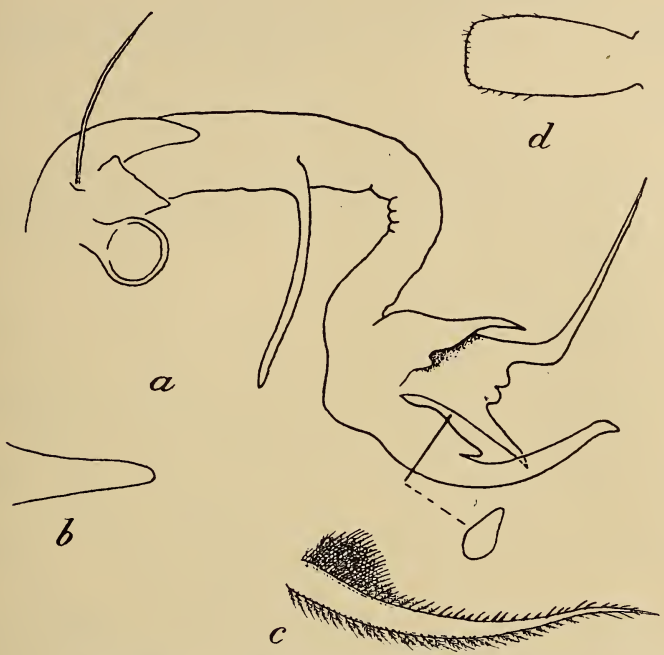

Fig. 18.—*Streptocephalus macrourus* Daday. *a*, Head and left 2nd antenna of ♂ (right 2nd antenna removed); *b*, frontal process; *c*, left ramus of caudal furca of ♂; *d*, 2nd antenna of ♀.

Locality.—Cape Province: Kimberley (S. Afr. Mus. and Kimberley Mus.).
Orange Free State: Bloemfontein (Daday and Albany Mus.).
Transvaal: junction of Marico and Crocodile rivers.
Ovamboland: several localities (Barnard, 1924).

Type ♂ in Paris Museum, ♀ in South African Museum.

Easily distinguished by the long caudal furca and the *two rounded* teeth between the two prongs of the thumb of 2nd antenna in ♂.

Streptocephalus gracilis Sars.

(Text-fig. 19.)

1898. *Streptocephalus gracilis.* Sars, Arch. Naturv. Krist., xx, 4, p. 17, pl. ii.
1910. ,, ,, Stebbing, Ann. S. Afr. Mus., vi, p. 483.
1910. ,, ,, Daday, Ann. Sci. Nat., xi, p. 352, fig. 65.

♂. Abdominal segments with numerous small asperities on dorsal surface. Rami of caudal furca stout, ensiform, both margins with

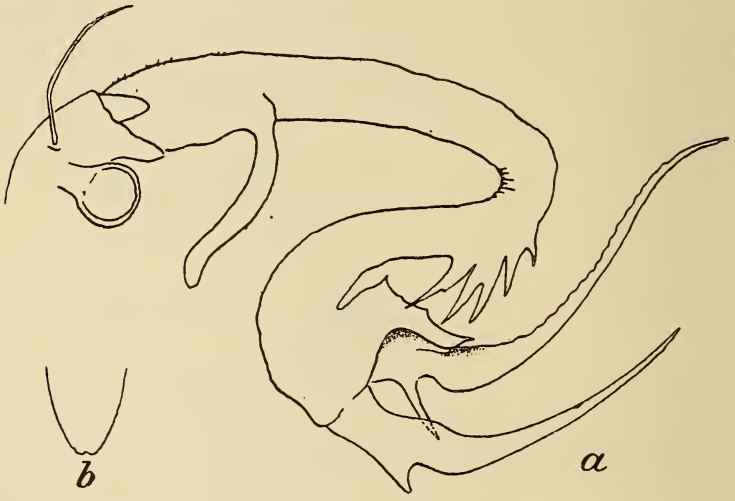

Fig. 19.—*Streptocephalus gracilis* Sars. *a*, Head and left 2nd antenna of ♂ (right 2nd antenna removed); *b*, frontal process.

long plumose setae, except near apex on inner margin where the setae are simple, short, spiniform. Frontal process short, deflexed, conical, apically obtuse or minutely notched. Second antenna moderate, basal part minutely setulose, appendix apically subtruncate, middle part with a series of small dentiform processes on outer and lower margins (Daday; not present in the type, and not mentioned by Sars), lower margin just beyond bend with 4–5 large teeth, thumb bifurcate, anterior margin angular and ending in a tooth, anterior prong long, slender, arcuate, upper margin crenulate, posterior prong

short, acute, finger movable, long, tapering to an acute apex, a strong tooth on posterior margin near base.

♀. Second antenna oblong, with apical point. Rami of caudal furca with plumose setae on both margins. Ovisac long.

Length.—13 mm.

Colour.—Translucent, caudal furca not coloured (Sars).

Locality.—Cape Province : Port Elizabeth (Sars).

Type in South African Museum.

Streptocephalus proboscideus (Frfld.).

(Text-fig. 20.)

1873. *Branchipus* (*Streptocephalus*) *proboscideus.* Frauenfeld, Verh. k.k. zool. bot. Ges. Wien, xxiii, p. 189.

1877. ,, ,, *proboscideus.* Brauer, SB. Ak. Wiss. Wien, lxxv, p. 602, pl. vi, figs. 13, 14.

1910. *Streptocephalus proboscideus.* Daday, Ann. Sci. Nat., xi, p. 395, fig. 80.

1921. ,, ,, Pesta, Ann. Naturh. Mus. Wien, xxxiv, p. 96.

1924. ,, ,, Barnard, Ann. S. Afr. Mus., xx, p. 221.

♂. Abdominal segments smooth. Rami of caudal furca rather stout, ensiform, with rather short plumose setae on both margins. Frontal process long, deflexed, and coiled backwards in repose, with a single or double row of spiniform processes on lower margin varying in number and size, apex bifid, with short tuberculiform knobs, which are also variable in development. Second antenna long, a few small tooth-like processes on inner surface of basal part ; appendix rather long, slender, apically acute, some large tooth-like processes on middle part at and beyond the bend, and one or more near junction with hand ; thumb bifurcate, basally spoon-shaped, anterior margin ending in a tooth, anterior prong long, geniculate, tapering to an acute apex, posterior prong short, apically acute, between the two prongs a short triangular tooth ; finger movable, geniculate, basal half stout, with two large lobe-like teeth on anterior margin, distal half slender, apically acute.

Juv. ♂. Specimens 8 mm. long have a short frontal process apically

notched (similar to that of adult *dregei*), 2nd antenna short, with simple thumb and finger (similar to that of young *cafer*) ; specimens 10 mm. long have the frontal process reaching just beyond end of basal part of 2nd antenna, without processes, apex bifid (fig. 20, *e*), 2nd antenna with thumb bifurcate and basal teeth on finger beginning to show (fig. 20, *b*) ; specimens 12 mm. long have the frontal process reaching to bend of 2nd antenna, but without or with very small processes on lower margin, hand nearly like that of adult but finger and anterior prong of thumb not geniculate (fig. 20, *c*).

Fig. 20.—*Streptocephalus proboscideus* (Frfld.). *a*, Head and left 2nd antenna of adult ♂ (right 2nd antenna removed) ; *b*, *c*, left 2nd antennae of juv. ♂ of 10 mm. and 12 mm. respectively ; *d*, normal apex of frontal process ; *e*, apex of frontal process of juv. ♂ of 10 mm. ; *f*, apex of frontal process of a Lake Chrissie specimen ; *g*, left 2nd antenna of ♀.

♀. Second antenna ovate, with minute apical point. Rami of caudal furca similar to those of ♂. Ovisac long.

Length.—13–29 mm. (♂), 12–24 mm. (♀).

Colour.—Translucent, caudal furca orange.

Locality.—Cape Province : Moloppo River, 45 miles N. of Upington ; Achabdam (Gordonia District).

Damaraland : Gobabis (Kimberley Mus.).

Ovamboland : Onambeke, S.W. of Ondongua.

Transvaal : Lake Chrissie ; Benoni ; Heidelberg.

Distribution.—Chartoum (Sudan).

Type in Vienna Museum.

In the South African Museum specimens the processes on the lower

side of the "proboscis" are arranged sometimes in a single row, sometimes irregularly or more or less in two rows, seldom so definitely in two rows as in the Sudan specimen figured by Brauer.

The specimens collected by myself at Achabdam are the largest I have seen, not only of this species but of any of the South African species.

Streptocephalus cladophorus Brnrd.

(Text-fig. 21.)

1924. *Streptocephalus cladophorus.* Barnard, Ann. S. Afr. Mus., xx, p. 222.

♂. Abdominal segments smooth. Rami of caudal furca rather short, straight, with long plumose setae on both margins. Frontal

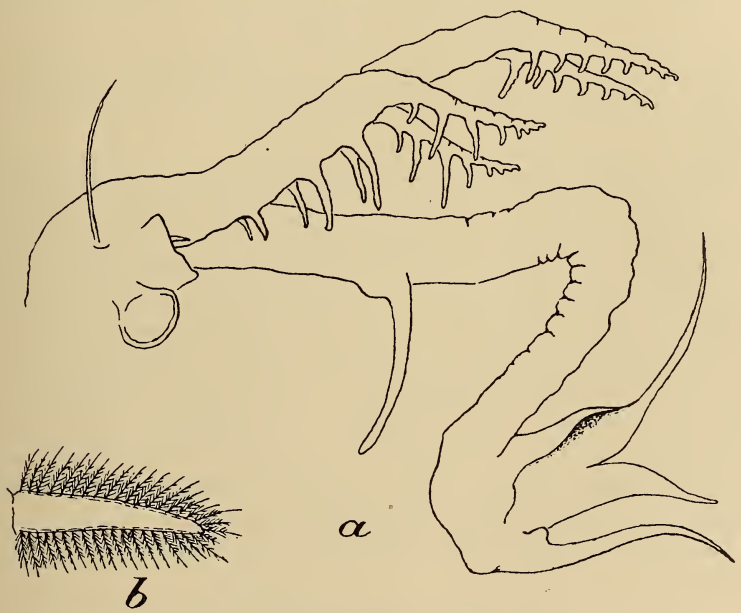

Fig. 21.—*Streptocephalus cladophorus* Brnrd. *a*, Head and left 2nd antenna of ♂ (right 2nd antenna removed); *b*, right ramus of caudal furca.

process elongate, apically bifid, and with a lateral branch about half-way along, lower margins with spiniform processes. Second antenna long, a very small acute process on inner surface at base (not mentioned in original description), appendix apically subacute, thumb bifurcate, basally spoon-shaped, the anterior margin not ending

in a tooth, anterior prong tapering to a long fine point, posterior prong shorter, apically acute, finger movable, long, slender, curved, apex acute, a rounded tooth on anterior margin at base, and sometimes another similar one about half-way along.

♀. Second antenna oblong, with small apical point. Rami of caudal furca similar to those of ♂. Ovisac long.

Length.—11–14 mm.

Colour.—Translucent, with various shades of pale blue, blue-green, or violet; colour in ♀ brighter than in ♂; caudal furca bright orange.

Locality.—Cape Province: Vryburg.

Transvaal: Heidelberg.

Ovamboland: various localities (Barnard, 1924).

Type in South African Museum.

Order 2. NOTOSTRACA.

1867. *Notostraca.* Sars, Crust. d'eau douce Norv., pp. 5, 6.

1902. *Notophylla.* Stebbing, Encycl. Brit., ed. 10, vol. xxviii (Suppl., vol. iv), p. 269.

Body elongate, more or less covered dorsally with a broad shield-like carapace which is attached anteriorly to the head, tapering posteriorly, and ending in a long, caudal furca. A varying number of the posterior segments without legs (apodous). Two sessile compound eyes close together on dorsal surface of head, with a minute obscure ocellus in front of them. Antennae greatly reduced or absent. Trunk-limbs (legs), 40–63 pairs, of which 29–52 are post-genital; the first pair with the endites filiform, often very long. The rami of the caudal furca very long, multiarticulate. Genital ducts opening on the 11th segment. Ova retained in a capsular ovisac formed by the 11th pair of trunk-limbs. No special prehensile organs in the male. Young hatched in the Metanauplius stage.

Distribution world wide. Males sometimes much rarer than females.

Fam. APODIDAE.

1834. Burmeister, Organization of Trilobites.

1892. Bernard, The Apodidae, Nature Series, London.

1896. Sars, Fauna Norvegiae, i, p. 67.

(Sometimes incorrectly written *Apusidae.*)

With the characters of the order.

There are two well-known genera: *Apus* and *Lepidurus.* In 1921

a third, *Proterothriops*, was proposed by Ghigi, but Gurney has given reasons for not admitting this genus, and for not splitting up the genus *Apus* without a very thorough consideration of individual and local variation based on a large amount of material (1924, p. 566). Gurney's remarks are here endorsed.

Key to the genera.

1. Last abdominal segment (telson) produced as a supra-anal plate . *Lepidurus.*
2. Telson not produced . . . . . *Apus.*

Gen. Lepidurus Leach.

1816.	*Lepidurus.*	Leach, Dict. des Sci. Nat., i, p. 259.
1883.	,,	Packard, U.S. Geol. Geogr. Surv. Territ., xii, p. 315.
1896.	,,	Sars, Fauna Norv., i, p. 67.
1917.	,,	Herriott, Trans. New Zeal. Inst., xlix, p. 284 (habits, etc.).
1921.	,,	Ghigi, Atti. Soc. Ital. Sci. Nat., lx, pp. 178, 182.
1924.	,,	Henry, Proc. Linn. Soc. N.S.W., xlix, p. 123.

Carapace very large, as a rule leaving only the last few segments exposed. Last segment (telson) produced as a thin, flat, supra-anal plate between the caudal filaments. First pair of legs with comparatively short endites, scarcely projecting beyond edge of carapace. Never more than 8 apodal segments. Ova larger than in *Apus*.

Lepidurus and *Apus* are well differentiated on the above structural characters, but there is also a very interesting biological difference between the two genera.

By means of breeding experiments, Brauer (SB. K. Ak. Wiss. Wien, lxxv, p. 586 *et sqq.*, 1877) found that the ova of *Lepidurus* were unable to develop if they were desiccated, whereas in the case of *Apus* desiccation was a necessary condition without which the eggs would not hatch. He found that the eggs of *Apus* can be exposed to the hottest sun without harm, but that those of *Lepidurus* will not hatch if allowed even to become dry ; and also that *Lepidurus* needs a low temperature (not higher than 17·5° C.) for its development, while *Apus* can endure a considerably higher temperature. He shows that in Europe *Lepidurus* is confined to peat moors and bogs which never dry up.

Miss Herriott was evidently unaware of any of Brauer's papers,

otherwise she would have recognised the probable explanation why the eggs of *Lepidurus viridis* did not hatch in her laboratory (*loc. cit.*, p. 286).

Although not since repeated and confirmed, one cannot doubt Brauer's results, seeing that they explain so convincingly the marked contrast in the present-day habitats and distribution of the two genera. *Lepidurus* is confined to the more boreal portions of the Palaearctic and Nearctic regions, New Zealand, Tasmania, the south-west and south-east coastal belts of Australia and Patagonia. In regions of a hotter and more arid climate, subject to periodical droughts, it is replaced by *Apus*. The limits of distribution of the two genera overlap in places, but in general the above marked separation holds good.

In Africa the only *Lepidurus* yet recorded is a fossil form from the Cave Sandstone Beds of the Stormberg Series of Upper Triassic age. This occurrence is extremely interesting. Haughton (*loc. cit.*, *infra*, pp. 469, 478) considers that the climate at the commencement of Stormberg times was cool with a discontinuous rainfall, and that there was a gradual change towards semi-arid and arid conditions throughout the deposition of the Stormberg Series. A wholesale extinction of invertebrate life must have taken place during the succeeding outpouring of the Stormberg (Drakensberg) lavas.

† *Lepidurus stormbergensis* Htn.

1924. *Lepidurus stormbergensis*. Haughton, Ann. S. Afr. Mus., xii, p. 328, and pp. 449, 481.

Carapace (as preserved, *i.e.* flattened out) almost circular, but its length (including posterior angles) slightly greater than its breadth, posterior sinus deep, its margin without visible denticulation, median keel moderate or strong.

About 14–17 segments exposed behind carapace ; number of apodal segments apparently 7–8, each with 6–9 spines.

Telson equal to the last 3–4 segments together, spatulate or lanceolate, the apex being rounded or pointed, with well-marked mediodorsal keel which is not visibly dentate.

Caudal rami at least as long as length of carapace, covered with fine setae as in recent species.

First pair of legs short, not projecting beyond edge of carapace.

Total length of carapace.—Up to 19 mm.

From shale band in the Cave Sandstone, Stormberg Series, Wodehouse, Cape Province.

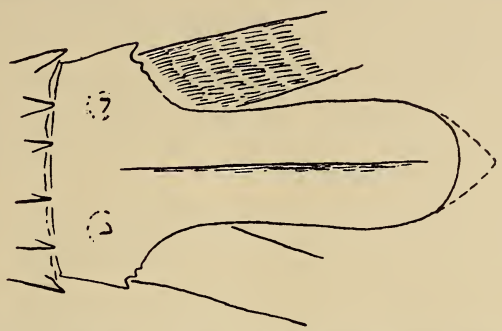

Fig. 22.—Restoration of telson of *Lepidurus stormbergensis* Htn. (from specimens 5754, 5762, 5763).

Gen. Apus Schfr.

1756. *Apus.* Schaeffer, Monogr. d. krebsart. Kieferf., p. 131.
1798. ,, Cuvier, Tabl. élém., pp. 454 and 700 (emend. pro *Apos* Scop.).
1801. ,, Latreille, Hist. nat. Crust., iv, p. 186.
1802. ,, Bosc, Crust., ii, p. 244 (emend. pro *Apos* Scop.).
1803. *Triops* and *Triopes.* Schrank, Fauna Boïca, iii, p. 251.
1841. *Apus.* Zaddach, De Apodis cancriformis anat.
1873. ,, Brauer, Verh. zool. bot. Ges. Wien, xxiii, p. 193 (biology).
1877. ,, *Id.*, SB. Ak. Wiss. Wien, lxxv, p. 583 (biology).
1883. ,, Packard, U.S. Geol. Geogr. Surv. Territ., xii, p. 319.
1886. ,, Simon, Ann. Soc. ent. Fr., ser. 6, vol. vi, p. 423.
1909. *Triops.* Keilhack, Zool. Ann. Wurzburg., iii, p. 177.
1910. *Apus.* Stebbing, Ann. S. Afr. Mus., vi, p. 484.
1911. ,, Kemp, Rec. Ind. Mus., vi, p. 353.
1921. *Thriops.* Ghigi, Att. Soc. Ital. Sci. Nat., lx, p. 162.
1921. *Proterothriops.* *Id.*, *ibid.*, p. 166.
1923. *Apus.* Gurney, Ann. Mag. Nat. Hist., (9), xi, p. 496.
1923. *Thriops.* Colosi, Att. Soc. Ital. Sci. Nat., lxii, p. 75.
1923. *Proterothriops.* *Id.*, *ibid.*, p. 81.
1924. *Thriops.* Ghigi, *ibid.*, lxiii, p. 193.
1924. *Apus.* Gurney, Ann. Mag. Nat. Hist., (9), xiv, p. 559.

It is quite clear that, according to the strict application of the Law of Priority, *Apus* should be applied to a genus of birds; but

common usage and common sense, as Gurney argues, should be regarded in this case as outweighing other considerations, especially as the names *Cypselus* (or *Micropus*), *Cypselidae*, etc., are well established in ornithology.

Carapace not as large as in *Lepidurus*, leaving more of the segments exposed. No telsonic supra-anal plate. First pair of legs with very long endites. Frequently more than 8 apodal segments. Ova smaller than in *Lepidurus*.

Apus has a nearly world-wide distribution, inhabiting regions which are more or less arid and subject to periodical droughts. It seems to prefer muddy water in contrast to *Lepidurus*, which prefers clear water.

Land and freshwater animals are frequently subject to considerable variation, both individual and local, and systematists are confronted with a great abundance of forms which it is difficult to classify into sharply defined species. *Apus* affords a good example of such variation and taxonomic difficulties. Nearly all authors agree as to the extreme difficulty of finding clear-cut specific characters by which to distinguish examples from different parts of the world. Several " species " have been described from inadequate material or even single specimens. This procedure of describing " specimens " and not " species " is bound to cause confusion, and its aftermath of " specific " names sunk in synonymy. The difficulties arise when later students try to identify their material, and fit their specimens into the already described species.

In the following pages some account is given of a study of the variation in a fairly considerable amount of material from several localities in South Africa. Approximately 500 specimens have been examined, and special attention has been paid to the variation found in batches of specimens collected at one and the same time and place. The amount of material is really small compared with what is desirable in dealing with variable characters ; but it seems to be larger than any hitherto studied by other authors, and the results may be considered as having a certain value.

Dealing first with variations in characters which have been regarded as significant for diagnostic purposes, we find :

1. The shape of the carapace as shown by the two extreme forms—oval in *numidicus* and round in *namaquensis*—is constant. I have not seen any transitional forms. Taken in conjunction with other characters as well, this feature may certainly be used in a specific diagnosis ; but it is quite valueless as applied to other species, *e.g.* *numidicus* and *sudanicus*.

2. The surface of the carapace may be perfectly smooth and polished, finely shagreened, minutely granular, or covered with closely set or scattered prickles or asperities, either wholly or only on the posterior angles. There is every gradation between the perfectly smooth and the completely rough forms. Roughness occurs quite sporadically in individuals, though more commonly in the female than the male, and in large examples rather than in small ones. It cannot therefore be used to characterise species or even local varieties. *A. trachyaspis* and *sculleyi* become merely synonyms of *numidicus* and *namaquensis* respectively (and *madagassicus* of *sakalavus*).

Very few examples (less than 1 per cent.) were found in which in rough specimens the asperities were so aggregated along the carina as to make the latter denticulate as in some forms of *cancriformis* (*mauritanicus*) ; and in these cases the amount of denticulation was dependent on the degree of roughness of the rest of the carapace.

3. The number of denticles on the posterior sinus or concave margin of the carapace is very variable : in *numidicus* from 34–55, in *namaquensis* from 46–54. It is an individual and not a specific character.

4. The flagella or endites of the 1st leg and the rami of the caudal furca are subject to a certain amount of variation in length, but mutilation during life occurs very frequently and renders these characters nugatory for taxonomic purposes. The endites and furcal rami on opposite sides often show disparity in length. The 4th endite is sometimes no longer than the 3rd. As a rule, however, the 4th endite is shorter than the carapace in *namaquensis*, as long as or a little longer than the carapace in *numidicus* ; but it is not a clear-cut character.

The caudal rami are certainly relatively short in *namaquensis*, moderately long in *numidicus*, and very long in *cancriformis*. The specimens of *namaquensis* described by Sars had unusually short rami.

5. The number of segments exposed behind the carapace in dorsal view is a character so obviously dependent on the manner of preservation that it is remarkable that it should ever have been considered a specific character. Even in the same batch of specimens subjected to exactly the same treatment some specimens will be strongly contracted, while others will be in varying degrees of relaxation. In some cases where the preserving fluid has not been sufficiently strong to preserve the internal tissues properly, all the segments can be drawn out to nearly double their normal length by merely picking

the animal up by the end of its tail. This accounts for the length of the " tail " in Sars' figure of the ♂ *namaquensis*. The extent to which the spines on the segments overlap the following segment is also for the same reason not a taxonomic character. In the case of living animals, however, it is possible to distinguish in a general way a " short-tailed " species like *cancriformis* from a " long-tailed " species like *namaquensis* ; or the " medium-tailed " species *numidicus* from both these.

6. The number of apodal segments, on the other hand, is a valuable taxonomic character. True, variation within certain limits is common, but when a sufficiently large number of specimens is examined an average can be struck which can be regarded as the normal number characteristic of the species. Individual specimens will, of course, crop up which, if judged by this character alone, will give trouble in identification.

In counting these segments the telson is always included. But the interpolation of an incomplete segment immediately preceding the telson occurs fairly often. This incomplete segment is visible on one or the other side, or only on the dorsal surface. It accounts for the number 18 given by Sars for the ♂ of *namaquensis*. In this work such incomplete segments are not counted.

From an examination of some 450 specimens of the oval-carapaced form *numidicus* it has been found that males with 12–15 segments, females with 9–13, occur. As the numbers 14 and 15 (♂), 12 and 13 (♀) occur also in the form *namaquensis*, single specimens were left out of account, only batches of specimens being considered. The numbers of segments occurred in the following percentages :—

♂.—12, 9 per cent. ; 13, 30·5 per cent. ; 14, 30·5 per cent. ; 15, 24 per cent.

♀.—9, 18 per cent. ; 10, 30·5 per cent. ; 11, 25 per cent. ; 12, 18 per cent. ; 13, 8·5 per cent.

Thus the normal number of segments in this species appears to be 13–14 in the male, 10 in the female ; and the most frequent variation in both sexes is the addition of 1 segment. It will be noticed that *somalicus* Wed. and *zanoni* Col. fall within these limits, and should probably be reckoned synonymous with *numidicus*.

In a much smaller series of the round-carapaced form *namaquensis* the following percentages were found :—

♂.—14, 34 per cent. ; 15, 42 per cent. ; 16, 13·5 per cent. ; 17, 10·5 per cent.

♀.—12, 28·5 per cent. ; 13, 50 per cent. ; 14, 21·5 per cent.

The normal number is thus 15 in the male, 13 in the female, and the most frequent variation is the omission of 1 segment.

The variation of +1 in *numidicus* and −1 in *namaquensis* might seem to imply that there is really only the one species. A combination of the two series results in the normal number of segments being 14–15 in the male. But one has to take into account the shape of the carapace, which, as already remarked, shows no transition between the definitely oval and the definitely round contours. Thus *namaquensis* appears to be a definable and valid species.

It is to be regretted, however, that an equally long series was not

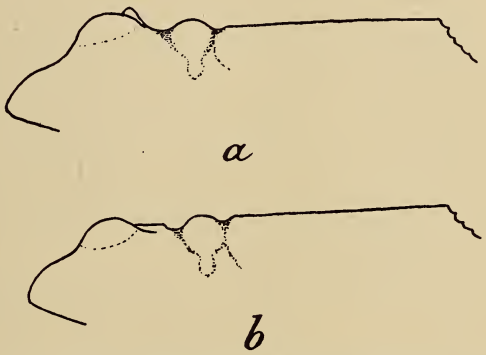

Fig. 23.—Profile of carapace to show shape of nuchal organ in : *a*, *Apus sudanicus* and *cancriformis*, and *Lepidurus viridis* ; *b*, *Apus numidicus* and *namaquensis*, and *Lepidurus arcticus*.

available of *namaquensis*, or of *sudanicus* and *cancriformis*, as of *numidicus*.

7. The nuchal organ, or postocular tubercle (Sars), or cervical gland (Bernard). In dorsal view this organ shows as a whitish pellucid spot which may be triangular, subcircular, or oval in shape ; the triangular shape is sometimes somewhat ovoid or trapezoidal. How far slight variations in form or size, as seen in preserved specimens, may be due to the method of preservation has not been determined. Nor does it matter much, because the essential difference lies not in the shape of the pellucid area so much as in the shape and position of the *raised* area as seen in profile. When the organ is triangular it forms a flattened depressed tubercle situated mostly behind the level of the hind margin of the eyes ; when oval it forms a bluntly conical tubercle situated between the hinder portions of the eyes and as high as, or even a little higher than, the eyes. In profile the shape and position are very distinctive (text-fig. 23).

The depressed, triangular form is found in *A. numidicus, namaquensis, sakalavus* (Nobili's description is quite clear on this point),* and in *Lepidurus arcticus* (from Norway). *A. zanoni* also has a triangular organ, but whether it is also depressed is not stated.

The oval, conical type is found in *A. cancriformis* and *sudanicus*, and in *Lepidurus viridis* (from Australasia).

Ghigi has used the shape of the pellucid area as seen in dorsal view as one of the characters of his genus *Proterothriops*. Gurney (1924, p. 565) doubts the validity of it as a generic distinction. From the fact that the same difference occurs in *Lepidurus* as well as in *Apus*, I am inclined to agree with Gurney that it is not of generic importance, though it is valuable as a specific character.

8. The presence or absence of spines on the dorsal and ventral surfaces of the telsonic segment is neither constant nor correlated with other characters, and cannot be used as a specific character. Specimens in which the ventral surface is quite or almost smooth occur in the same batches with others in which it is more or less spinose or even strongly spinose. Spines are usually more strongly developed in males than in females.

Thus the characters most useful for taxonomic purposes appear to be : the shape of the nuchal organ and the average number of apodal segments, the shape of the carapace, and, to a lesser extent, the length of the 4th endite of the 1st leg.

Using these characters a very considerable reduction in the number of species is possible ; *e.g.* taking only the African fauna, from about 17 species to 5, or perhaps only 4. As a purely tentative suggestion the following synopsis is given.

I. Nuchal organ depressed, triangular.
  A. Apodal segments ♂ 12–15, ♀ 9–13 (average ♂ 13–14, ♀ 10). 4th endite of 1st leg about as long as carapace.
    1. *numidicus* Gr. (syn.: *dispar, trachyaspis, somalicus, zanoni,* and *dukianus*).
    2. *sakalavus* Nob. (syn.: *madagassicus*).
  B. Apodal segments ♂ 14–17, ♀ 12–14 (average ♂ 15, ♀ 13). 4th endite of 1st leg rather shorter than carapace.
    3. *namaquensis* Richt. (syn.: *sculleyi*).

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* " Semiovato-subtriangolare, depresso-subescavato." Nobili says further there is a small granule in the centre, evidently similar to that mentioned and figured by Sars (1898) in *numidicus*. I have not seen a trace of this " small circular knob " in any specimen, not even in some of the original specimens raised by Sars from dried mud and sent to this Museum.

II. Nuchal organ conical, oval.
  A. Apodal segments ♂ 9–13, ♀ 7–8.
    4. *sudanicus* Br. (syn.: *numidicus* Bouv. non Gr., *abyssinicus*, *uebensis*).
  B. Apodal segments ♂ 6–8, ♀ 5–7.
    5. *cancriformis* Sch. (syn.: *simplex*, *mauritanicus*, *ovamboensis*, and *apulius*).

A. sakalavus should probably be united with *numidicus*. *A. bottegoi* Prato may be either *sudanicus* or *cancriformis*; it has 7 apodal segments, but the sex is not stated. I have not seen Prato's paper and do not know whether the nuchal organ was described, and, if so, what was its shape.

Sexual Characters.—In addition to the egg-capsule on the 11th pair of legs, and the greater number of apodal segments in the male, there seem to be only two other secondary sexual characters.

The differences in the 2nd–5th pairs of legs seem to have been somewhat overrated (Sars, 1898; Thiele, 1907; Ghigi, 1921). These legs are certainly stronger and more robust in the male, as Sars says, but in the South African material I have failed to find any other constant or noteworthy differences in the appendages of the two sexes.

Gurney (1924) has well illustrated the difference in armature of the caudal furca in *numidicus*. Packard (1883) noticed this difference in some of the North American species, and Thiele (1907) briefly referred to a similar difference in *madagassicus*, which is the male of *sakalavus*. In *numidicus* and *namaquensis* the rami of the furca in the male are broader and more tumid at the base than in the female; they often diminish rather suddenly in diameter (at about the point where they are cut off in Gurney's figures), whereas in the female they taper off gradually and evenly.

The spines on the segments, especially on the ventral surface, are much stronger and more numerous in the male than in the female, often partaking of the same blunt or scale-like shape of those found on the base of the caudal furca.

Other characters, such as the number of joints in the endites of the 1st pair of legs (Ghigi, 1921), the denticles on the posterior sinus of the carapace (Ghigi, 1921), or the shape and roughness of the carapace (Thiele, 1907), are not constant sexual characters.

The differences in the shape of the caudal rami and the armature of the rami and the segments is not marked in *sudanicus* or *cancriformis*. Further research might show that these features are possibly correlated with the shape of the nuchal organ, in which case there might be some reason for separating a "Proterothriops" group of species within the genus *Apus*.

Key to the South African species.

1. Nuchal organ depressed, triangular.
   a. Carapace oval. Apodal segments (average) ♂ 13–14, ♀ 10 . *numidicus.*
   b. Carapace round. Apodal segments (average) ♂ 15, ♀ 13 . *namaquensis.*
2. Nuchal organ conical, oval.
   a. Apodal segments ♂ 11, ♀ 8–10 (usually 9) . . . . *sudanicus.*
   b. Apodal segments ♂ 6–8, ♀ 5–7 . . . . . *cancriformis.*

Apus numidicus Grube.

(Text-fig. 25, *b*.)

1865. *Apus numidicus.* Grube, Arch. Naturg., xxxi, p. 278, pl. xi, figs. 14, *a*, *b*.
1877. ,, *dispar.* Brauer, SB. K. Ak. Wiss. Wien, lxxv, p. 589, pl. i.
1880. ,, *dukianus.* Day, Proc. Zool. Soc. Lond., p. 392, text-fig.
1893. ,, *numidicus*, var. *strauchii.* Braem, Zeitsch. wiss. Zool., lvi.
1898. ,, ,, Sars, Arch. Naturv. Krist., xx, 4, p. 5, pl. i.
1899. ,, ,, *Id.*, *ibid.*, xxi, 4, p. 6.
1899. ,, *trachyaspis.* *Id.*, *ibid.*, xxi, 4, p. 15, pl. ii, figs. 1, 2.
1905. ,, *numidicus.* *Id.*, *ibid.*, xxvii, 4, p. 3.
1910. ,, ,, Stebbing, Ann. S. Afr. Mus., vi, p. 484.
1910. ,, *trachyaspis.* *Id.*, *ibid.*, p. 485.
1924. ,, *numidicus.* Barnard, *ibid.*, xx, p. 214 (part).
1924. ,, ,, Gurney, Ann. Mag. Nat. Hist., (9), xiv, p. 559, figs. 1, 2.

Probable further synonyms are :

1895. *Apus somalicus.* Wedenissow, Bull. Soc. ent. Ital., xxvi.
1899. ,, ,, Pavesi in Robecchi Bricchetti "Somali e Benadir," pp. 699, 700.
1920. ,, *zanoni.* Colosi, Monit. Zool. Ital., xxxi, p. 120.
1921. *Proterothriops zanoni.* Ghigi, Att. Soc. Ital. Sci. Nat., lx, p. 167, fig. 3.
1922. *Apus zanoni.* Colosi, *ibid.*, lxi, p. 293.
1923. ,, *somalicus.* *Id.*, *ibid.*, lxii, p. 81.

Nuchal organ depressed, triangular or subtriangular or trapezoidal. Carapace oval, its length (*i.e.* including the posterior angles) a little

greater than its width, more or less arched, usually convex along whole lateral margin to posterior angle. Number of apodal segments normally 13 or 14 in ♂, 10 in ♀, varying from 12–15 in ♂, 9–13 in ♀. Denticles on posterior sinus of carapace 34–55. Fourth endite of

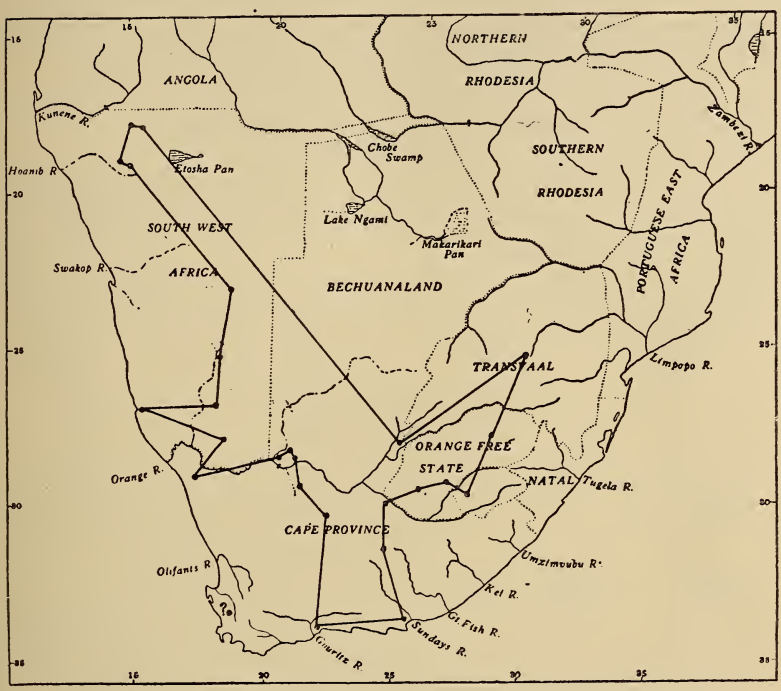

Fig. 24.—Recorded localities of the genus *Apus* in South Africa. (See legend to fig. 2.)

1st leg usually as long as or a little longer than carapace. Caudal rami about as long as carapace, including posterior angles.

Length.—Carapace (from anterior margin to hind end of median carina) up to 24 mm. (♂ and ♀).

Colour.—Horn or amber colour, more or less greenish or olivaceous, eyes dark brown or black with pale or reddish margins, extremities of exposed legs often pinkish, eggs salmon or dark red.

Locality.—Basutoland : Morajia.

CapeProvince : De Aar (Transvaal Mus.) ; Port Elizabeth ; Hanover ; Mossel Bay ; Petrusville ; Kimberley ; Gordonia District ; Kenhardt ; Carnarvon ; Berg River (probably in the Piquetberg area).

Bechuanaland : Asbestos Mts. (J. H. Power).
Orange Free State : Bethlehem (Durban Mus.) ; Bloemfontein and Ladybrand (Albany Mus.).
Transvaal : Witbank ; Rietfontein ; Heidelberg.
Great Namaqualand : Great Fish River near Gibeon.
Damaraland : Gobabis (Kimberley Mus.).
Ovamboland : Ondongua ; Onolongo ; Uwuthija.*
Kaokoveld : Kamanyab ; Choabendus.

Distribution.—Northern Africa, Arabia, Afghanistan.

Type of *trachyaspis* in South African Museum.

This is by far the commonest and most widely distributed species in South Africa. The smallest ovigerous ♀ I have seen was 9 mm. in median length of carapace.

Bouvier (1899, Ann. Mus. Civ. Genova, ser. 2, vol. xix, p. 576) wrongly states that this species has 8–9 apodal segments.

Apus namaquensis Richt.

(Text-fig. 25, *a*.)

1886. *Apus namaquensis.* Richters, Ber. Senckenb. Ges., p. 31.
1899. ,, ,, Sars, Arch. Naturv. Krist., xxi, 4, p. 6, pl. i, figs. 1–8 (as a n.sp.).
1899. ,, *sculleyi.* *Id.*, *ibid.*, p. 12, pl. i, figs. 9–13.
1907. ,, *elongatus.* Thiele, SB. Ges. naturf. Fr. Berlin, 1907, No. 9, p. 290 (nom. nov. for *namaquensis* Sars).
1910. ,, *namaquensis.* Stebbing, Ann. S. Afr. Mus., vi, p. 485.
1910. ,, *sculleyi.* *Id.*, *ibid.*, p. 485.
1913. ,, ,, Daday, Voy. Afr. Orient. Alluaud. Phyllop, p. 9.
1924. ,, *namaquensis.* Barnard, Ann. S. Afr. Mus., xx, p. 214.

Nuchal organ depressed, triangular. Carapace circular, only very slightly, if at all, longer than broad, flattened, lateral margins usually slightly concave near the posterior angles. Number of apodal segments normally 15 in ♂, 13 in ♀, varying from 14–17 in ♂, 12–14 in ♀. Denticles on posterior sinus 46–54. Fourth endite of 1st leg usually

* The specimens recorded by me in 1924 from Kalkfontein South and Ongka prove, on closer examination, to belong to *sudanicus*.

a little shorter than carapace. Caudal rami in ♀ usually not longer than median length of carapace, in ♂ often considerably shorter.

Length.—Carapace (median length) up to 20 mm. (♂ and ♀).

Colour.—Horn or amber colour, often more or less olivaceous, eyes dark, ova pinkish or dark red.

Locality.—Cape Province : Bushmanland (=Little Namaqualand) (Sars) ; Aries, Narugas, Langklip (these three localities in the Gordonia District) ; Upington ; Kimberley.
Great Namaqualand : Angra Pequena (=Lüderitzbucht) (Richters) ; Kalkfontein South.

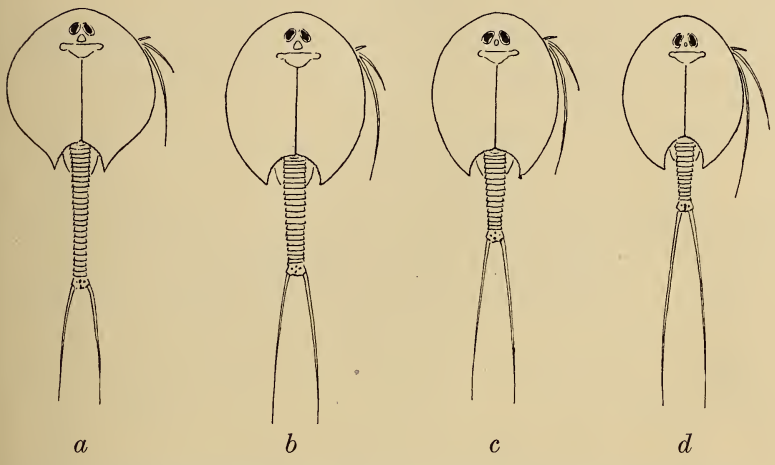

Fig. 25.—Semidiagrammatic figures of the four South African species of *Apus* : *a, namaquensis* ; *b, numidicus* ; *c, sudanicus* ; *d, cancriformis.*

Distribution.—Kinangop in British East Africa (Daday).

Types of *namaquensis* Sars and *sculleyi* in South African Museum.

In view of the limited and compact distribution of this species in South Africa, its discovery in British East Africa is interesting. Unfortunately Daday, though he had a large number of both sexes, merely gave measurements and no indication of, *e.g.*, the variation in the number of apodal segments. A re-examination of these specimens is desirable.

The largest specimens I have seen came from Upington in the Gordonia District. In three localities in the same district I have collected very small examples, including an ovigerous ♀ only 5 mm., and the largest ♂ only 9 mm. ; in all these specimens the nuchal organ is relatively very large and distinctly trapezoidal in shape.

It is impossible to say whether the small size of the animals and the large size of the nuchal organ is in any way due to a slight brackishness in the water.

The number 18, given by Sars for the apodal segments in the ♂, is due to an aberration in one of the types ; the segment before the telson being an incomplete one visible only on the dorsal surface. Sars' figure 5 is incorrect, though figure 4 of the dorsal surface is correct. The other type ♂ has 17 complete segments.

The remarkable shortness of the caudal furca as described by Sars in the ♂ is unusual, but the rami are characteristically shorter in this species than in the others, especially so in the male.

This species was named after Mr. W. C. Scully, formerly Resident Magistrate in Namaqualand, but the name was incorrectly spelt by Sars.

Apus sudanicus Br.

(Text-fig. 25, *c*.)

1877. *Apus sudanicus*. Brauer, SB. Ak. Wiss. Wien, lxxv, p. 590.
1886. ,, *abyssinicus*. Richters, Ber. Senckenb. Ges., p. 32.
1893. ,, *sudanicus* var. *chinensis*. Braem, Zeitsch. wiss. Zool., lvi, p. 180.
1924. ,, *numidicus*. Barnard, Ann. S. Afr. Mus., xx, p. 214 (part).

Probable further synonym :

1922. *Thriops uebensis*. Colosi, Att. Soc. Ital. Sci. Nat., lxi, p. 296.

Nuchal organ conical, oval. Carapace oval, slightly longer than broad, more or less arched, lateral margins not concave near posterior angles. Number of apodal segments in ♂ 11, in ♀ 8–10 (usually 9 in ♀). Number of denticles on posterior sinus 44–56. Fourth endite of 1st leg about as long as carapace. Caudal rami about as long as carapace including posterior angles.

Length.—Carapace (median length) up to 22 mm. (♀).

Colour.—Horn or amber colour, more or less olivaceous, eyes dark, eggs reddish.

Locality.—Cape Province : Kimberley ; Upington ; Moloppo River 45 miles N. of Upington.
Great Namaqualand : Kalkfontein South ; Keetmanshoop.
Ovamboland : Ongka (N. of Ondongua).

Distribution.—Khartoum, Ailar, and N. of Cairo. (China ?)

The South African specimens are assigned to this species on account of the agreement in the number of apodal segments. I have not seen any authentic specimens.

Apus cancriformis Sch.

(Text-fig. 25, *d.*)

1756.	*Apus cancriformis.*	Schaeffer, Monogr. d. krebsart. Kieferf.
1877.	,, ,,	Brauer, SB. Ak. Wiss. Wien, lxxv, p. 592.
1886.	,, ,,	Simon, Ann. Soc. ent. Fr., ser. 6, vol. vi, p. 425.
1893.	,, ,,	Braem, Zeitsch. wiss. Zoll., lvi, p. 183.
1909.	*Triops* ,,	Keilhack, Susswasserfauna Deutschl., Hft. 10, Phyllop.
1911.	*Apus* ,,	Kemp, Rec. Ind. Mus., vi, p. 353.
1921.	*Thriops* ,,	Ghigi, Att. Soc. Ital. Sci. Nat., lx, p. 170.
1921.	,, *mauritanicus.*	*Id., ibid.*, p. 175, fig. 9.
1921.	,, *apulius.*	*Id., ibid.*, p. 176, fig. 10.
1921.	,, *simplex.*	*Id., ibid.*, p. 177.
1923.	*Apus cancriformis.*	Gurney, Ann. Mag. Nat. Hist., (9), xi, p. 496.
1923.	*Thriops* ,,	Colosi, Att. Soc. Ital. Sci. Nat., lxii, p. 75.
1924.	,, ,,	Ghigi, *ibid.*, lxiii, p. 193.
1924.	*Apus ovamboensis.*	Barnard, Ann. S. Afr. Mus., xx, p. 215.

Nuchal organ conical, oval. Carapace oval, slightly longer than broad, more or less arched, lateral margins not concave near posterior angles. Number of apodal segments in ♂ 6–8, in ♀ 5–7 (usually 7 in ♂, 6 in ♀). Number of denticles on posterior sinus 32–36. Fourth endite of 1st leg longer than carapace. Caudal rami as long as, or even longer than, the rest of the animal.

Length.—Carapace (median length) up to 17 mm. (♀).

Colour.—Horn or amber colour, more or less olivaceous, eyes dark, eggs salmon or reddish.

Locality.—Ovamboland : several localities.

Distribution.—Europe, Northern Africa, Kashmir.

Type of *ovamboensis* in South African Museum.

This species is characterised by its short "tail" with the very long filaments. Further study has convinced me that *ovamboensis* is merely a synonym of *cancriformis.*

Order 3. CONCHOSTRACA.

1867. *Conchostraca.* Sars, Crust. d'eau douce Norv., pp. 5, 6.
1902. *Conchophylla.* Stebbing, Encycl. Brit., ed. 10, vol. xxviii (Suppl., vol. iv), p. 269.
1913. *Conchostraca.* Daday, Math. Termt. Ert., xxxi, p. 561 (classification in Hungarian).
1915. ,, *Id.*, Ann. Sci. Nat., ser. 9, vol. xx, p. 39.
1923. ,, *Id.*, *ibid.*, ser. 10, vol. vi, p. 255.
1925. ,, *Id.*, *ibid.*, ser. 10, vol. viii, p. 143.

Body short, enclosed within a bivalve shell, ending posteriorly in a claw-like caudal furca (except *Lynceidae*). Front of head produced downwards, forming a frontal process or rostrum. Paired compound eyes sessile, more or less confluent ; ocellus placed below the compound eyes. First antennae short or long, unjointed, 2-jointed, or many-jointed. Second antennae natatory, biramous. Trunk-limbs (legs) 10–27 pairs, of which 0–16 are post-genital. Rami of caudal furca short, claw-like. Genital ducts opening on 11th segment. Ova retained within the shell attached to the 9th–15th pairs of legs. Young hatched in the Nauplius stage, or (*Cyclestheria*) the development takes place within the shell of the mother.

Distribution world-wide.

For fossil representatives of this order see under the family *Cyzicidae.*

Key to the South African families.

I. Shell very tumid, without growth-lines. Head very large. Caudal furca absent . . . . . *Lynceidae.*
II. Shell laterally compressed.
  A. Shell with few and indistinct growth-lines.
    1. Shell circular in side view . . . . . *Cyclestheriidae.*
    2. Shell ovate in side view . . . . . *Limnadiidae.*
  B. Shell with numerous and distinct growth-lines.
    1. Rostrum (in adult) unarmed (or with a minute spine in ♀) *Cyzicidae.*
    2. Rostrum armed with a distinct apical spine in both sexes *Leptestheriidae.*

Fam. LYNCEIDAE.

1896. *Limnetidae.* Sars, Fauna Norveg., 1 Phylloc. og Phyllop, p. 116.
1902. *Lynceidae.* Stebbing, Zoologist, p. 101.
1902. ,, *Id.*, *loc. cit.*, p. 270.

1910. *Lynceidae.* *Id.*, Ann. S. Afr. Mus., vi, p. 486.
1913. ,, Daday, Math. Termt. Ert., xxxi, pp. 566, 588.

Shell very tumid, subglobular, without growth-lines, hinge rather long. Head large, without frontal appendage, with distinct fornix on each side extending to end of rostrum. Rostrum spatulate, unarmed, more or less differing in shape in the two sexes. Eyes contiguous in front. First antenna short, 2-jointed, clavate, apex with sensory setae. Second antenna moderate. Ten (♂), 12 (♀) pairs of legs ; 1st pair (rarely also one of the 2nd pair) in ♂ prehensile ; 9th and 10th pairs in ♀ ovigerous. Caudal furca absent. Telson covered below by a laminate operculum. A lobed lamellate process on each side in ♀ arising from the last 2 segments, apparently for the purpose of supporting the egg-masses.

World-wide, in fresh-water.

The members of this family are easily recognised by the tumid shell and large head.

Gen. Lynceus O. F. Müll.

1776. *Lynceus* (part). O. F. Müller, Zool. Dan. Prodr., pp. xxvii, 199.
1816. ,, Leach, Encycl. Brit., ed. 5, p. 406.
1847. *Limnetis.* Loven, K. Vet. Ak. Handl., lxvi (for 1845), p. 430.
1848. *Hedessa.* Lieven, Schr. naturf. Ges. Dantzig, iv, Hft. 2, p. 4.
1853. *Limnetis.* Grube, Arch. Naturg., xix, p. 71.
1883. ,, Packard, U.S. Geol. Geogr. Surv. Territ., xii, p. 298.
1907. *Lynceus.* Thiele, SB. Ges. naturf. Fr. Berlin, 1907, p. 294.
1910. ,, Stebbing, *loc. cit.*, p. 486.
1913. ,, Daday, Math. Termt. Ert., xxxi, p. 589 (key to species in Hungarian).
1926. *Limnetis.* Gurney, Intern. Rev. Hydrob., xvi, p. 114 (figs. of *Nauplius* larva).

Only the 1st pair of legs in the ♂ prehensile.

In the only other genus, *Lynceopsis* Daday, one of the 2nd pair of legs, either the right or the left, is also prehensile.

In his 1913 paper (of which I have seen a translation) Daday subdivides the genus into *Lynceus* sensu stricto and *Eulynceus* n. subg. In the former the prehensile legs of the ♂ are similar on the two sides and the terminal claw or finger is usually narrow and scythe-shaped ; in the latter the legs on the two sides differ in shape and the terminal claw is usually stout.

All the South African species belong to *Lynceus* s. str. I have not been able to refer them to any of the species mentioned in Daday's key. It is greatly to be regretted that Daday did not live to publish a revision of this family with detailed descriptions and figures as he did for most of the other families of *Conchostraca*.

Four South African species are here listed, though it has not been possible to identify with certainty Loven's species *wahlbergi*. Of the two Ovamboland species several additional characters are noted which were omitted in the preliminary diagnosis. A further new species is described from Bechuanaland.

Of the two Madagascan species—*rotundus* Thiele, 1907, and *madagascarensis* Thiele, 1907—we have detailed accounts and figures of the prehensile legs of the ♂, but no figures of the rostra. Both these species require redescribing and figuring.

Key to the South African species.

1. Rostral keel double in both sexes.
   - *a.* Fornix running to end of rostrum, *i.e.* rostrum spatulate, in both sexes *bicarinatus.*
   - *b.* Fornix running to end of rostrum in ♀, but to middle of lower margin in ♂, *i.e.* rostrum spatulate in ♀, truncate in ♂ . . . *pachydactylus.*
2. Rostral keel single in both sexes. Rostrum truncate in both sexes.
   - *a.* Granules on proximal joint of 1st leg ♂ . . . . . *truncatus.*
   - *b.* No granules on proximal joint of 1st leg ♂ . . . . *lobatsianus.*

Lynceus bicarinatus Brnrd.

(Text-fig. 26, *h.*)

1924. *Lynceus bicarinatus.* Barnard, Ann. S. Afr. Mus., xx, p. 224, pl. xxvi, figs. 12–15.

Shell subcircular, slightly deeper anteriorly. Profile of head above eyes nearly straight. Rostrum with double median keel in both sexes, fornix running to apex of rostrum and ending in a small projection, apex spatulate, truncate, rather more convex in ♀ than ♂, margin in both sexes crenulate. Opercular plate below telson with margin excised. Prehensile leg in ♂ with distal joint trapezoidal, the " palm " distinct from rest of margin, the longer of the 2 terminal appendages tapering distally, margin facing exopod with about 6–8 stout tubercles, finger moderately slender and curved, not exceeding palm ; proximal joint with very short and unornamented margin facing the very stout exopod. Posterior lamella of ♀ with 3 marginal

processes and 1 accessory process on dorsal surface near junction with body.

Diameter.—Up to 8 mm.

Colour.—Horny with a slight greenish tinge.

Locality.—Ovamboland : several localities.

Type in South African Museum.

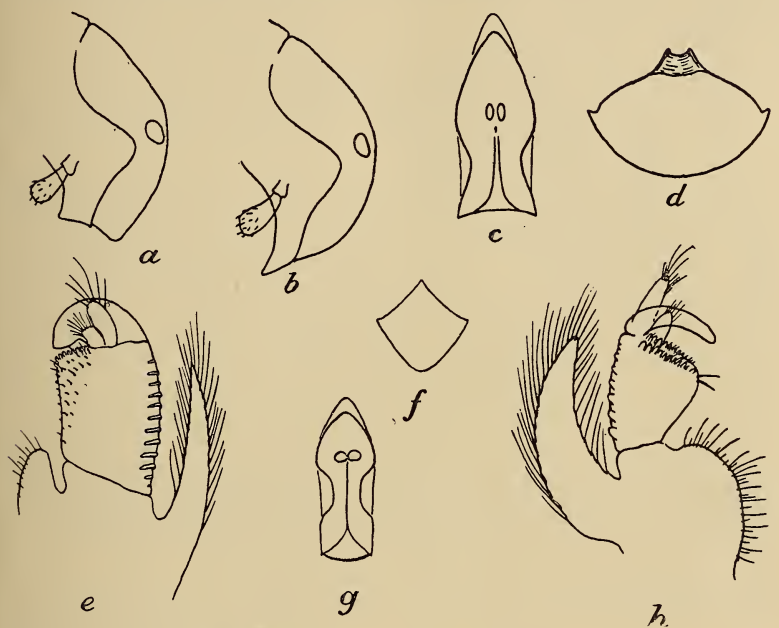

Fig. 26.—*Lynceus pachydactylus* n. sp.: *a*, Profile of head ♂; *b*, profile of head ♀; *c*, frontal view of head ♂; *d*, ventral view of rostrum ♂; *e*, prehensile leg of ♂. *L. lobatsianus* n. sp.: *f*, Ventral view of rostrum ♂; *g*, frontal view of head ♀. *L. bicarinatus* Brnrd.: *h*, Prehensile leg of ♂.

Lynceus pachydactylus n. sp.

(Text-fig. 26, *a–e.*)

Shell subcircular, slightly deeper anteriorly. Profile of head above eyes nearly straight. Rostrum with double median keel in both sexes, truncate in ♂, spatulate in ♀, fornix running to middle of lower margin in ♂, to apex in ♀, lower hind margin crenulate in ♀; the truncate lower end of rostrum in ♂ oval, hind margin evenly convex, not crenulate, the ends of the fornices forming small points. Opercular plate below telson bilobate in both sexes, larger in ♂ than ♀.

Prehensile leg in ♂ with distal joint oblong, " palm " short but distinct, with about 10 stout blunt pines, margin facing exopod with 10–12 transverse ridges, finger very stout, short, nearly semicircular in outline, the longer of the two terminal appendages scarcely projecting beyond margin of finger ; proximal joint with very short and unornamented margin facing exopod. Posterior lamella in ♀ with 3 marginal processes.

Diameter.—Up to 5 mm.

Colour.—Horny, eggs yellowish or salmon.

Locality.—Transvaal : Rietfontein (between Pretoria and Johannesburg) ; Heidelberg.

Type in South African Museum.

This species resembles *madagascarensis* Thiele and *massaicus* Thiele in the short thick finger of the prehensile leg of ♂, but the shape of the " hand " is different. In other respects also it is close to *massaicus*, as, *e.g.*, in the short terminal appendages of the " hand " of the ♂ and the posterior lamella in the ♀. The shape of the rostrum in both sexes appears to be very similar in these two species. Thiele's figure (1900, Zool. Jahrb. Syst., xiii, pl. xxxviii, fig. 31) of the ♂ does not quite correspond with his text, and gives the impression that it is not a full lateral view, but has the lower end of the rostrum tilted up and the continuation of the line representing the lower margin omitted. If this were so, the fornix would run to the middle of the lower margin as in *pachydactylus*. The two species, however, are easily separated by the prehensile legs of the ♂.

Lynceus truncatus Brnrd.

(Text-fig. 27.)

1924. *Lynceus truncatus.* Barnard, Ann. S. Afr. Mus., xx, p. 224, pl. xxvi, figs. 5–11.

Shell subcircular, slightly deeper anteriorly. Profile above eyes straight or slightly concave. Rostrum with a single median keel in both sexes, distally truncate, fornix running to about middle of lower margin (viewed laterally) and ending in small spiniform projections ; in ♂ lower end of rostrum appears diamond-shaped, the median keel forming an acute projection in front, the posterior end also forming a sharp angle ; in ♀ the lower hind end of rostrum is shovel-like, with the margin finely denticulate. Opercular plate below telson much reduced in ♀, much broader than long, margin convex ; in ♂ obsolete. Prehensile leg of ♂ with the distal joint

oblong, longer than broad, the curved rather slender finger closing between two rows of stout spines and spine-setae, the longer of the two terminal appendages somewhat club-shaped at apex, proximal joint with the long margin facing the slender exopod set with numerous transverse rows of minute granules. Posterior lamella of ♀ with 3

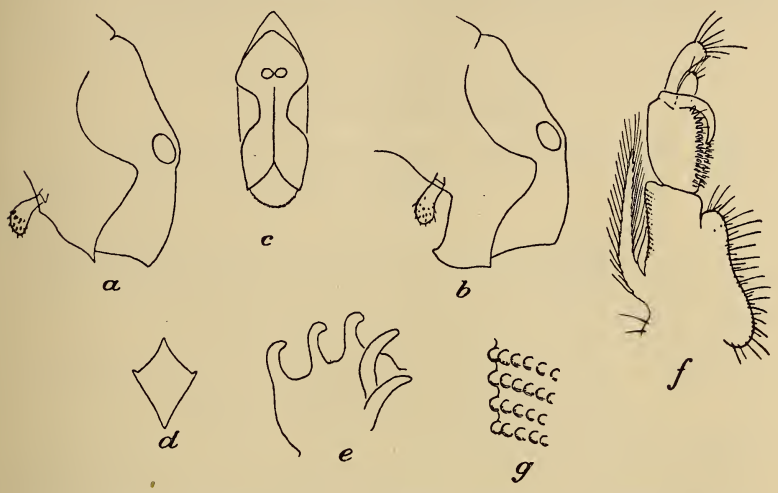

Fig. 27.—*Lynceus truncatus* Brnrd. *a*, Profile of head ♂; *b*, profile of head ♀; *c*, frontal view of head ♀; *d*, ventral view of rostrum ♂; *e*, left posterior lamella ♀, dorsal view, anterior end to right; *f*, prehensile leg ♂; *g*, granules on proximal joint of latter further enlarged.

marginal processes curving downwards and 2 (sometimes 3) accessory processes on dorsal surface.

Diameter.—3 mm.

Colour.—Horny.

Locality.—Ovamboland : Ukualuthi.

Type in South African Museum.

Lynceus lobatsianus n. sp.

(Text-fig. 26, *f*, *g*.)

Very similar to *truncatus*. Truncate apex of rostrum in ♂ in ventral view less elongate, diamond-shaped, the median keel and fornices less prominent, and the hinder angle more rounded. Lower hind end of rostrum in ♀ less produced. Opercular plate not reduced in ♀ or absent in ♂, margin convex. Proximal joint of prehensile leg of ♂ without rows of granules on margin facing exopod.

Diameter.—2·5–3 mm.

Colour.—Horny.

Locality.—Bechuanaland : Lobatsi (J. H. Power).

Type in Kimberley Museum, cotype in South African Museum.

This form may prove to be a variety only of *truncatus*, but in the absence of intermediates the two forms are very distinct.

Species insufficienter descripta.

Lynceus wahlbergi (Loven).

1847. *Limnetis wahlbergi.* Loven, *loc. cit.*, p. 430, pl. iv.

1904. „ „ Gurney, Proc. Zool. Soc. Lond., ii, p. 299.

♀.—Shell subcircular, deeper anteriorly. Profile of head straight above eyes, strongly and evenly convex below. Rostrum with a double median keel, fornix running to apex of rostrum.

Diameter.—3 mm.

Locality.—" In paludibus terrae Caffrorum Natalensium " (Loven).*

Orange Free State : Kroonstad (Gurney).

Type in Stockholm Museum.

Loven (and Gurney) had only female specimens, consequently there remains a doubt as to the exact identity of this form. One or the other of the bicarinate species, *bicarinatus* or *pachydactylus*, is probably really the same as Loven's species, but as the doubt will always remain it is better to take no account of the name *wahlbergi*.

Thiele (1900, Zool. Jahrb. Abt. Syst., xiii, p. 572, pl. xxxviii, figs. 26–38) identified a ♂ and ♀ from Massai Nyika (Tanganyika) as this species, but later (1907, SB. Ges. naturf. Fr. Berlin, p. 294, footnote) regarded them as distinct under the name *massaicus*. The ♀, and it seems the ♂ also, has a double rostral keel, thus resembling *jeanneli* and *bicarinatus* ; the prehensile leg of the ♂, however, is very distinct.

Fam. CYCLESTHERIIDAE.

1888. *Limnadiidae* (part). Sars, Vid. Selsk. Skr. Forh. Krist. for 1887, i.

1913. *Cyclestheriidae.* Daday, Math. Termt. Ert., xxxi, pp. 566, 588.

Shell thin, pellucid, laterally compressed, subcircular in outline, with few and inconspicuous growth-lines, hinge short. Head without

* See note on locality under *Streptocephalus cafer*.

frontal appendage, with rudimentary fornices. Rostrum compressed, securiform, apically serrate. Eyes fused into one. First antenna rather long, simple, unjointed. Second antenna strong. Sixteen pairs of legs, 1st in ♂ prehensile. Caudal furca claw-like.

The development takes place within the shell of the mother without any free-swimming stage.

Only one genus.

Gen. Cyclestheria Sars.

1888. *Cyclestheria.* Sars, *loc. cit.*, pp. 5, 6.
1913. ,, Daday, *loc. cit.*, p. 588.

With the characters given above.

Widely distributed in tropical and subtropical regions.

Cyclestheria hislopi (Baird).

(Text-fig. 28.)

1859. *Estheria hislopi.* Baird, Proc. Zool. Soc. Lond., p. 232, pl. lxiii, figs. 1, 1*b*.
1886. *Limnadia* ,, Brady, J. Linn. Soc., xix, p. 294, pl. xxxvii, figs. 1–3.
1888. *Cyclestheria* ,, Sars, *loc. cit.*, p. 8, pls. i–viii.
1898. ,, ,, Weltner, SB. Ges. naturf. Fr. Berlin, p. 199.
1900. ,, ,, Thiele, Zool. Jahrb. Abt. Syst., xiii, pp. 564, 576.
1903. ,, ,, Sayce, Tr. Roy. Soc. Vict., xv, 2, p. 256, pl. xxxvi, fig. *c*.
1913. ,, ,, Daday, Voy. Alluaud. Afr. orient. Crust., p. 3.
1913. *Eulimnadia victoriae.* Brady, Ann. Natal Mus., ii, p. 469, pl. xxxvii, figs. 1–7.
1924. *Cyclestheria hislopi.* Barnard, Ann. S. Afr. Mus., xx, p. 223.

Up to the present only one species has been recognised, though Thiele (*loc. cit.*, p. 576) regards the Brazilian form as specifically distinct. It is easily recognised by the family diagnosis and the figures here given.

Diameter.—4–5 mm.

Colour.—Horny with a slight greenish tinge.

Locality.—Rhodesia : Victoria Falls (Brady).
Ovamboland : several localities (Barnard).
Portuguese East Africa : Quilimane (Thiele).

Distribution.—India (Baird), Ceylon (Brady), Queensland, Celebes, East Africa, Brazil (Sars), British East Africa (Daday).

Type (of *hislopi*) in British Museum, of *victoriae* ? lost.

It seems a little remarkable that Brady, in describing this form as a new species in 1913, did not recognise it as the same as that which he had examined and figured in 1886 from Ceylon. He does not

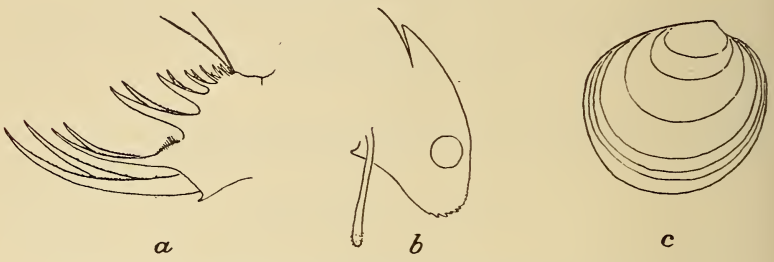

Fig. 28.—*Cyclestheria hislopi* (Baird). *a*, Telson and caudal furca ; *b*, head ; *c*, lateral view of shell.

state that the Victoria Falls specimen actually had 18 pairs of legs, though he mentions that *Eulimnadia* is distinguished from *Limnadia* by that number. According to Daday's more recent work this generic distinction does not hold good.

Fam. LIMNADIIDAE.

1896. *Limnadiidae* (part). Sars, Fauna Norv., i, p. 84.
1913. ,, Daday, Math. Termt. Ert., xxxi, pp. 566, 584.
1925. ,, *Id.*, Ann. Sci. Nat., ser. 10, vol. viii, p. 143.

Shell thin, pellucid, laterally compressed, ovate in outline, with few and inconspicuous growth-lines, often slightly dimorphic in the two sexes, hinge rather long. Head with frontal appendage (in adult), without fornices. Rostrum compressed, apex unarmed. Eyes contiguous. First antenna moderately long, anterior margin with short rounded lobes bearing sensory setae. Second antenna rather strong. Eighteen to thirty-two pairs of legs ; 1st and 2nd pairs in ♂ prehensile ; 9th and 10th, and sometimes also 11th, pairs in ♀ each with a long filamentous appendage (exopod) to which the egg-mass is attached. Caudal furca claw-like.

Daday (1925) recognised three genera : *Limnadia*, *Eulimnadia*, and *Limnadopsis*. *Paralimnadia* Sars is regarded as a synonym of *Limnadia*, though the shell with its numerous growth-lines might be considered a good generic character. *Limnadopsis* has a serrate hinge-line and more numerous legs.

Eulimnadia was defined by Packard as having only 18 pairs of legs, but Daday does not adopt this as a distinguishing feature. It has also been considered distinct from *Limnadia* on account of its being bisexual; up to the present no males have been seen of the typical species of *Limnadia* (*L. lenticularis*). As this argument might any day be put out of court by the discovery of males of one of the species of *Limnadia*, I agree with Daday that structural characters alone should be the criterion for separating these two genera, if indeed it be deemed worth while to separate them at all. Daday relies upon the presence (*Eulimnadia*) or absence (*Limnadia*) of an acute projection on the lower distal angle of telson as a distinguishing feature. If this is the only feasible character, the separation of the two genera seems insecure, and Daday himself felt (*loc. cit.*, p. 147) that later authors might regard both genera, and even *Limnadopsis*, as subgenera only of *Limnadia*.

Gen. Eulimnadia Pack. Dad.

1874.	*Eulimnadia*.	Packard, 6th Rep. Peabody Ac. Sc., p. 55.
1874.	,,	*Id.*, Hayden's U.S. Geol. Geogr. Surv. Rep. for 1873, p. 618.
1883.	,,	*Id.*, U.S. Geol. Geogr. Surv. Territ., xii, pt. 1, p. 311.
1895.	,,	Ishikawa, Zool. Mag. Tokio, vii, No. 76.
1896.	,,	Sars, Arch. Naturv. Krist., xviii, No. 8.
1902.	,,	*Id.*, *ibid.*, xxiv, No. 6.
1911.	,,	Wolf, Fauna S.W. Austral., iii, p. 270.
1913.	,,	Daday, Math. Termt. Ert., xxxi, pp. 584, 585 (key to species) (in Hungarian).
1914.	,,	Dakin, Proc. Zool. Soc. Lond., p. 298.
1925.	,,	Daday, Ann. Sci. Nat., ser. 10, vol. viii, p. 145 (species not dealt with).

Hinge-line of shell not serrate. Eighteen or twenty pairs of legs. Lower distal angle of telson produced in an acute point (Daday).

Eulimnadia africana (Brauer).

(Text-fig. 29.)

1877. *Limnadia africana.* Brauer, SB. K. Ak. Wiss. Wien, lxxv, p. 608, pls. vii, viii.
1913. *Eulimnadia* ,, Daday, Voy. Alluaud Afr. orient. Phyll., p. 3.
1913. ,, ,, *Id., loc. cit.*, p. 586 (defined in key to species) (in Hungarian).
1924. ,, ,, Barnard, Ann. S. Afr. Mus., xx, p. 223.

Shell oval, hinge-line slightly convex in ♂, more strongly so in ♀, anterior margin rounded and extending beyond anterior end of hinge-

Fig. 29.—*Eulimnadia africana* (Brauer). *a*, *b*, Lateral view of shell of ♂ and ♀ respectively; *c*, *d*, head of ♂ and ♀ respectively; *e*, 1st leg of ♂; *f*, telson and caudal furca (only one side drawn in); *g*, ovum.

line; growth-lines 6–7 in number, usually very indistinct, converging at anterior end, surface smooth, very minutely pitted. Rostrum in ♂ bluntly acute, in ♀ quadrate or rounded-quadrate. Eighteen pairs of legs. Tactile process (Calman) or endopodital palp (Daday) elongate,

longer on 2nd leg than on 1st, 2-jointed, 2nd joint longer than 1st, apically obliquely truncate and minutely setulose. Filamentous appendages (dorsal lobes of exopods) on 9th and 10th pairs of legs in ♀. Lower distal angle of telson produced in a short point; teeth on dorsal margin subequal in size. Caudal style with long plumose setae for nearly whole length, except near apex where the margin is minutely serrulate. Posterior 12 (about) segments each with mediodorsal tufts of setae, much larger in ♀ than ♂, where they pass into a single short spine on each of the last 3 or 4 segments. Ova spherical, rugulose.

Dimensions.—♂ 8·5×5 mm.; ♀ 9·5×7 mm.

Colour.—Pale horny, more or less tinged with green.

Locality.—Cape Province: Kimberley (Kimberley Mus.).
Bechuanaland: Lobatsi (J. H. Power).
Transvaal: Rietfontein; Heidelberg.
Rhodesia: Bulawayo (Rhodesia Mus.).
Great Namaqualand: Great Fish River near Gibeon.
Ovamboland: widely distributed (Barnard).
Kaokoveld: Choabendus.

Distribution.—Sudan (Brauer); British East Africa (Daday).

The tooth on the margin of the "hand" of the prehensile legs is much less strong in Brauer's figure than in the South African specimens. The ova are comparable with those figured by Sayce (1903, Tr. Roy. Soc. Vict., xv) for *E. rivolensis* (=*Limnadia sordida*).

Fam. CYZICIDAE.

Limnadiidae (part) and *Estheriidae* (part) auctorum.

1900. *Estheriidae* (part). Sars, Arch. Naturv. Krist., xx, No. 9, p. 10.
1910. *Cyzicidae* (part). Stebbing, Ann. S. Afr. Mus., vi, p. 486.
1913. *Caenestheriidae.* Daday, Math. Termt. Ert., xxxi, pp. 566, 567 (in Hungarian).
1915. ,, *Id.*, Ann. Sci. Nat., ser. 9, vol. xx, p. 49 (revision).

Shell thin, pellucid (but often rendered opaque with extraneous matter), laterally compressed, ovate in outline, with numerous and distinct growth-lines and more or less distinct surface sculpturing. Head without frontal appendage, with distinct fornix on each side extending to apex of rostrum. Rostrum unarmed, or with a minute

apical spinule in the young which may persist in adult ♀, but not in adult ♂. Eyes contiguous. First antenna long, with numerous lobes on anterior margin bearing sensory setae. Second antenna strong. Twenty to twenty-seven pairs of legs; 1st and 2nd pairs in ♂ prehensile, 9th and 10th pairs in ♀ ovigerous. Caudal furca claw-like. Foremost tooth on upper margin of telson larger and stronger than the following ones.

In examining the surface sculpturing the shell should in the first place be dried and observed by reflected light; but it should also be examined by transmitted light, and for this purpose the membrane on the inner side of the shell must be carefully removed.

The family should take its name from the oldest genus (*Cyzicus*), not from Daday's own genus.

Brief mention may be made of the fossil representatives of this order which occur in South Africa.

As the animal within the shell is not preserved (except in the case of *Limnestheria*, Wright, 1920) fossil species cannot with any certainty be ranged in the present-day families, though by a comparison of the shell characters we can perhaps say that the *Lynceidae*, *Cyclestheriidae*, and *Limnadiidae* have no fossil representatives, at least in South Africa.* The other two families, the *Cyzicidae* and *Leptestheriidae*, are scarcely distinguishable on shell characters alone, and we may therefore regard all the fossil species of "Estheria" as members of the former family.

As the name *Estheria* (Rüppell, 1837) is preoccupied (1830, Robineau-Desvoidy, Diptera) and the fossil species are not referable to any particular modern genus, Daday has proposed the name *Palaeestheria*. In 1912 Deperet and Mazeran (Bull. Soc. d'Hist. nat. d'Autun, xxv, p. 173) have subdivided the genus "Estheria" into groups. The group containing the majority of fossil species is characterised by the numerous regular concentric ribs, and is named *Euestheria*. I have not seen this paper, but apparently the name *Euestheria* is not to be regarded as a properly constituted generic or subgeneric name; it does not appear in the International Catalogue. Therefore Daday's name *Palaeestheria* should stand.

The following South African forms have been discovered.

* Reference, however, may be made to Mitchell, Proc. Linn. Soc. N.S.W., lii, 2, p. 105, 1927. Some of the fossil species described in this paper, e.g. *Estheria glenleensis*, pl. ii, fig. 6, and *E. lenticularis*, pl. iii, fig. 7, might justly be regarded as representatives of the *Limnadiidae* and *Cyclestheriidae* respectively, judging by the figures.

Gen. Palaeestheria Daday.

1915. Daday, Ann. Sci. Nat., ser. 9, vol. xx, p. 51.

† *Palaeestheria anomala* (Jones).

1901. Jones, Geol. Mag., dec. 4, vol. viii, p. 352, text-figs. 1–4.

A shortly oval or subrotund species, 5×3 mm., with a rather short hinge and no visible sculpture.

From the Enon Conglomerate at Heidelberg, Cape.

† *Palaeestheria draperi* (Jones and Woodw.).

1894. Jones and Woodward, Geol. Mag., dec. 4, vol. i, p. 289, pl. ix, figs. 1, *a–c*.

1894. *Id.*, *ibid.*, p. 290, pl. ix, figs. 2, *a*, *b* (*stowiana*).

1901. Jones, Geol. Mag., p. 354.

1924. Haughton, Ann. S. Afr. Mus., xii, p. 326 (*Cyzicus* (*Euestheria*) *draperi*).

Suboblong, hinge-line straight, up to 16×10·5 mm., interspaces between the ridges with coarse shallow pits.

From shale-band in the Cave Sandstone, at Harrismith, Orange Free State, and Wodehouse, Cape.

The small specimens described as *stowiana* were originally regarded as possibly the young of *draperi*, but in 1901 Jones maintained their distinctness on the ground that the full complement of ridges is present. Haughton unites both forms.

† *Palaeestheria greyi* (Jones).

1879. Jones, Geol. Mag., dec. 2, vol. v, p. 100, pl. iii, fig. 1.

A minute species, $\frac{1}{6}\times\frac{1}{10}$ inch, in shape somewhat resembling a *Limnadia*, but with numerous ridges. No visible sculpture.

From the Karroo Beds near Cradock.

† *Palaeestheria* sp.

Specimens of a *Palaeestheria* are in the Geological Survey Collection (Nos. 312–319 W), from the Lower Beaufort Beds, at Bosch Hoek near van Reenen's Pass, Orange Free State.

† *Palaeestheria* sp.

Some large specimens, 16–23 mm. in length, were collected by Dr. S. H. Haughton from the Cretaceous (Wealden) at Port Elizabeth. They show very numerous growth-lines, but no definite intervening sculpture ; they are comparable with *elliptica* Dnkr. from the Wealden of Europe.

Gen. Leaia Jones.

1862. Jones, Monogr. Foss. Estheria.

This genus is characterised by having two radiating ribs from the umbo to the lower margin. No living genus with similar shell characters is known.

† *Leaia* sp.

Specimens of this genus are in the collection of the Geological Survey (Nos. 298–311 W), from the Lower Beaufort Beds, 2 miles S. of Mooi River Station, Natal.

The largest is 7·5 × 4 mm. ; ovate, hinge straight in some specimens, curved in others ; umbo at anterior third ; anterior radiating rib runs perpendicularly to the hinge-line, the other rib nearly bisects the angle between the anterior rib and the hinge-line ; faint concentric striae are visible, but the direction of them does not appear to be abruptly altered by the ribs, at least not by the anterior rib, as in typical *Leaia*.

Key to the South African genera.

1. Rostrum in both sexes acute. Occipital angle of head (in adult) acutely pointed . . . . . *Caenestheriella.*
2. Rostrum in ♀ acute, in ♂ apically dilated, truncate, securiform. Occipital angle rounded or rounded-quadrate . . . . *Eocyzicus.*

Gen. Caenestheriella Daday.

1913. *Caenestheriella.* Daday, Math. Termt. Ert., xxxi, pp. 567, 570 (key to species in Hungarian).
1915. ,, *Id.*, Ann. Sci. Nat., ser. 9, vol. xx, p. 106.

Head with occipital angle in both sexes more or less acutely produced. Rostrum in both sexes apically acute. Teeth and spines on margin of telson spinulose.

Distributed over all continents except South America.

Daday (1915) has admitted 20 species to this genus, of which 11 are described as new. It seems reasonable to think that some of these will later be united. I am unable to find, *e.g.*, constant differences in the 3 South African species admitted by Daday.

Caenestheriella australis (Loven).

(Text-fig. 30.)

1847. *Cyzicus australis.* Loven, K. Vet. Ak. Handl. for 1845, p. 428, pl. iii.
1898. *Estheria elizabethae.* Sars, Arch. Naturv. Krist., xx, No. 4, p. 33, pl. iv.
1905. ,, ,, *Id., ibid.*, xxvii, No. 4, p. 3.
1910. *Cyzicus australis* and *elizabethae.* Stebbing, Ann. S. Afr. Mus., vi, p. 487.
1915. *Caenestheria* (?) *australis.* Daday, *loc. cit.*, p. 98, fig. 15.
1915. *Caenestheriella vidua.* *Id., ibid.*, p. 122, fig. 21.
1915. ,, *joubini.* *Id., ibid.*, p. 148, fig. 29.
1915. ,, *elizabethae.* *Id., ibid.*, pl. clxxv, fig. 37.
1924. ,, *elizabethae*, *joubini*, and *vidua.* Barnard, Ann. S. Afr. Mus., xx, pp. 225, 226.

Shell ovate, hinge-line forming a slight angle with posterior margin in ♀, this angle in ♂ obsolete, growth-lines forming strong ribs more or less closely set with fine setae, especially in young; sculpturing consisting of closely set fine punctures, which are arranged more or less in regular transverse lines leaving pellucid intervals, at least at front and hind ends and near central margin, but the linear arrangement often not too well marked, especially in the younger portions of the shell. Rostrum apically subacute in ♂, in ♀ acute and curved slightly forwards, in young very acutely pointed; at the apex of the groove formed by the fornices there is in the young a short stout spine (fig. 30, *f*) which in adult ♀ is much smaller and scarcely, if at all, projects beyond the margins of the fornices, or even becomes quite obsolete; in adult ♂ it is nearly always obsolete. I have seen a minute vestige of it in one specimen from Bulawayo, one from Gibeon, and one from Port Elizabeth. Occipital angle in young much less acutely produced than in adult. Telson with the two claws asymmetrical in ♂.

Dimensions.—Up to 10×6 mm.

Colour.—Shell corneous, animal reddish.

Locality.—Cape Province : Port Elizabeth (Sars) ; Hanover (Sars) ; Kimberley (Kimberley Mus.) ; Queenstown (Daday) ; Hutchinson ; Prince Albert ; Beaufort West ; Molteno ; Prieska ; Kenhardt ; Langklip, Narugas Siding, and Omdraaiputz (all three in the Gordonia District).
Bechuanaland : Kalahari, several localities (Daday) ; Asbestos Mts. (J. H. Power).
Orange Free State : Kroonstad (Gurney) ; Bloemfontein (Daday, and Albany Mus.).
Transvaal : " in paludibus terrae Caffrorum Natalensium (Loven).* Blaauwberg (Albany Mus.) ; Witbank ; Brakpan ; Heidelberg ; Wolmaranstad.
Rhodesia : Bulawayo (Rhodesia Mus.).
Great Namaqualand : Great Fish River near Gibeon ; Keetmanshoop ; Kalkfontein South.
Damaraland : Windhoek (Daday).
Ovamboland : several localities (Barnard).
Kaokoveld : Kamanyab.

Type of *australis* in Stockholm Museum ; of *elizabethae* in South African Museum ; of *vidua* in Berlin Museum ; of *joubini* in Paris Museum.

In the first place I agree with Wolf's opinion (*cf.* Daday, *loc. cit.*, p. 152) that *elizabethae* is synonymous with *australis*. Loven has figured the essential outstanding features of this widely distributed species, viz. the setose growth-lines of the shell and the acute rostrum. Young female specimens in particular correspond with Loven's words " angulo acuto terminatum spina armato." These words might be taken as applicable to *Leptestheria* but for the shape of the 1st leg of the ♂ figured by Loven. From the size and the rounded occipital angle of the head Loven's specimens were evidently not full grown.

As regards Daday's species *vidua* and *joubini*, after the examination of a large amount of material from numerous localities, I am unable to appreciate the constancy of the characters relied upon for distinguishing these forms from one another and from *elizabethae*.

The typical arrangement of the punctures on the shell is not always well seen, especially in young specimens ; it is best seen in adult shells at each end and near the ventral margin. The presence or absence of an angle where the hinge-line meets the posterior margin is, as Sars pointed out, largely a sexual character. The actual shape of the head is variable in both sexes ; the rostrum in some ♂♂ being

* See note on locality under *Streptocephalus cafer*.

comparatively stout (Daday's figure of *joubini*), in others slender (Daday's figure of *elizabethae*) ; the angle of the fornix just below the eye in ♀ may be very conspicuous (*vidua*), but I have seen all variations between this and the inconspicuous angle in *joubini*. Females with stout rostra occur in the same locality along with males with slender

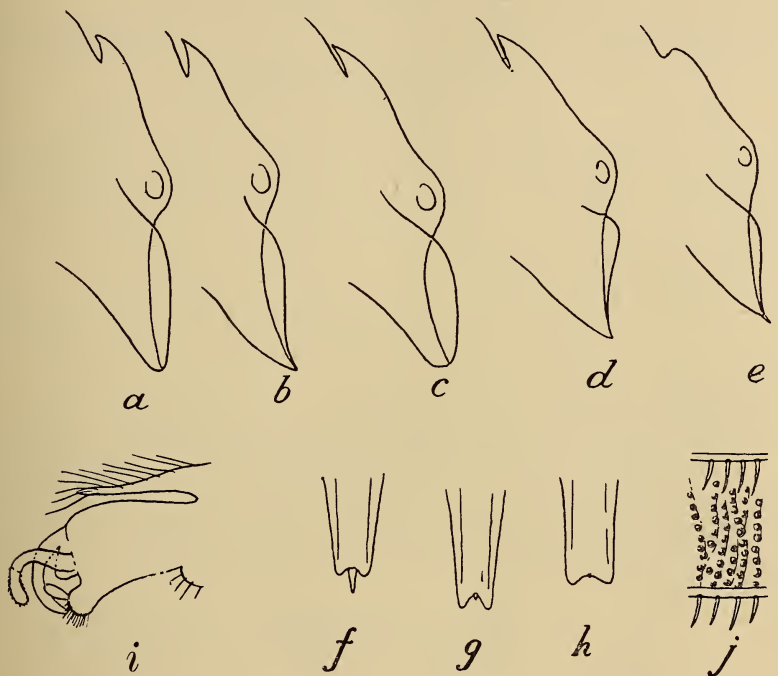

Fig. 30.—*Caenestheriella australis* (Loven). *a*, *c*, Heads of ♂ ; *b*, *d*, heads of ♀ ; *e*, head of young ; *f*, apex of rostrum of young ; *g*, apex of rostrum of adult ♀ ; *h*, apex of rostrum of adult ♂ (Bulawayo) ; *i*, 1st leg of ♂ ; *j*, sculpture of shell.

rostra. In general, the larger the specimen the more slender the rostrum in both sexes.

According to Daday the margin of the branchial epipod in *joubini* is entire, in *elizabethae* more or less crenulate, in *vidua* crenulate ; obviously not a decisive character.

The number of lines of growth is also an unreliable character.

C. paradoxa Daday, founded on a young female from the Niger River, shows the same projecting point or spine at the apex of the rostrum as does the young of *australis* ; and I am inclined to think that *paradoxa* may also prove to be synonymous with *australis*.

This is a very widely distributed species. The animals are more

sedentary than some of the other Conchostraca, lying embedded in the mud with the dorsal surface downwards, and the ventral margins of the shell just flush with the surface of the mud.

Gen. Eocyzicus Daday.

1913. *Eocyzicus.* Daday, Math. Termt. Ert., xxxi, pp. 567, 574 (key to species in Hungarian).
1915. ,, *Id.*, Ann. Sci. Nat., ser. 9, vol. xx, p. 190.

Head with the occipital angle in both sexes rounded or rounded-quadrate. Rostrum in ♀ acute, in ♂ apically dilated, securiform, rounded or truncate. Teeth and spines on margin of telson simple, smooth.

Mainly in Africa, but also in Asia and North America.

Key to the South African species.

1. Size about 6–7 mm.
   a. Rostrum in ♂ with anterior angle slightly less than a right angle. Margin of hand of ♂ slightly notched. Telson with fine denticles . *obliquus.*
   b. Rostrum in ♂ with anterior angle a right angle. Margin of hand deeply notched. Telson with strong denticles and claws . . *dentatus.*
2. Size about 13 mm. Rostrum in ♂ with anterior angle an obtuse angle. Margin of hand deeply notched. Telson with fine spiniform denticles . *gigas.*

Eocyzicus obliquus (Sars).

(Text-fig. 31, *a–c.*)

1905. *Estheria obliquus.* Sars, Arch. Naturv. Krist., xxvii, No. 4, p. 10, pl. ii.
1910. *Cyzicus* ,, Stebbing, Ann. S. Afr. Mus., vi, p. 487.
1915. *Eocyzicus* ,, Daday, *loc. cit.*, p. 222, fig. 50.

Shell ovate, deeper anteriorly, dorsal margin straight, passing imperceptibly into hind margin, growth-lines rather faint, forming low smooth ridges; sculpturing faint, consisting of very shallow ovoid or polygonal pits. Rostrum in ♀ triangular, apex subacute; in ♂ somewhat quadrangular, apex (anterior angle) rounded-quadrate, posterior angle broadly rounded and bevelled off. Profile of head from occipital angle to eye straight. Twenty-two pairs of legs. Anterior (inner) margin of the "hand" of prehensile legs in ♂ with a slight notch. Telson with the claws scarcely, if at all, asymmetrical in

♂, rather slender, smooth, preceded by about 12 small unequal denticles.

Dimensions.—Up to 7 × 4·5 mm.

Colour.—Shell corneous, animal pale yellowish white.

Locality.—Cape Province : Hanover (Sars).

Transvaal : Potchefstroom.

Type ubi ?

I have seen only Potchefstroom examples of this species ; apparently

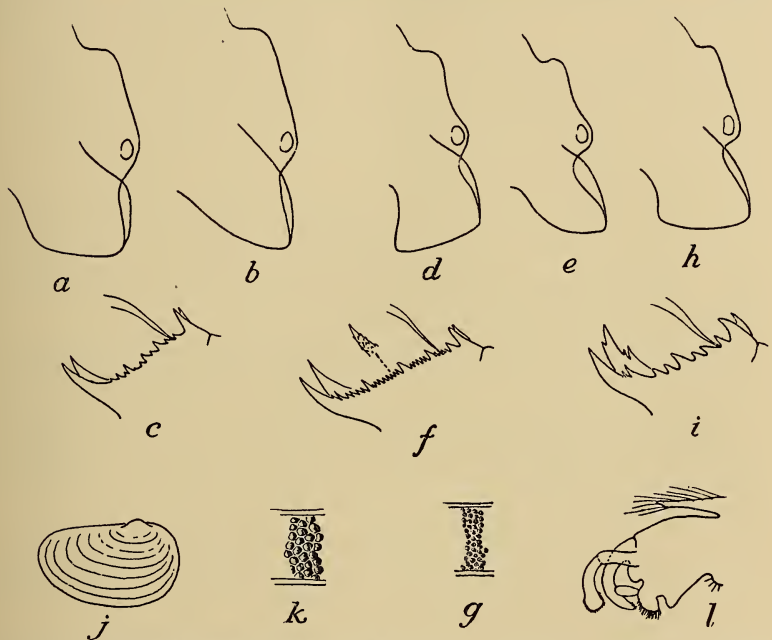

Fig. 31.—*Eocyzicus obliquus* Sars : *a*, Head of ♂ ; *b*, head of ♀ ; *c*, telson. *E. gigas* Brnrd. : *d*, Head of ♂ ; *e*, head of ♀ ; *f*, telson ; *g*, sculpture of shell. *E. dentatus* n. sp. : *h*, Head of ♂ ; *i*, telson ; *j*, shell ; *k*, sculpture of shell ; *l*, 1st leg of ♂.

none of the original set were returned to this Museum by Sars. Sars' description of the sculpturing of the shell was inadequate or even inaccurate ; it is more difficult to observe in this species than the others.

Eocyzicus dentatus n. sp.

(Text-fig. 31, *h–l.*)

♂.—Shell ovate, deeper anteriorly, dorsal margin passing imperceptibly into hind margin, growth-lines rather faint, smooth ; sculp-

turing consisting of irregularly ovoid, subcircular, or polygonal depressions, with intervening narrow raised network. Rostrum quadrangular, hind angle rounded-quadrate. Profile of head from occipital angle to eye straight. Twenty-two pairs of legs. Anterior (inner) margin of " hand " of prehensile leg of ♂ with a deep notch. Telson with the claws markedly asymmetrical, strong, the left one with accessory teeth on the anterior and posterior margins, the right one less strongly curved and with an accessory tooth on anterior margin ; 6–7 strong triangular denticles on upper margin, the foremost one very strong.

Dimensions.—6 × 4 mm.

Colour.—Shell corneous.

Locality.—Cape Province : Hanover.

Type in South African Museum.

The single ♂ specimen on which this species is founded was collected at the same locality as *E. obliquus*, but whether or not in the same pool is not recorded. It was recognised by the late Dr. Purcell as being different from the other four specimens he received from Hanover, but he did not send it to Sars.

The characters of the animal are so markedly distinct from those of *obliquus* that one can hardly doubt that it represents a separate species and not merely a variety of the latter. The telson, in fact, is quite distinct from that of any of the other species of the genus mentioned in Daday's monograph. Further specimens, however, would be welcome.

Some empty valves from Hutchinson (Cape Province) show the same sculpturing as this species, but in the absence of the animals, it is impossible to assign them definitely to one or the other species.

Eocyzicus gigas Brnrd.

(Text-fig. 31, *d–g.*)

1924. *Eocyzicus gigas.* Barnard, Ann. S. Afr. Mus., xx, p. 226, pl. xxvi, figs. 16, 17.

Shell ovate, deeper anteriorly, dorsal margin passing imperceptibly into hind margin, growth-lines rather faint, smooth ; sculpturing consisting of small closely aggregated pits (smaller than those in *dentatus*) with intervening narrow network. Rostrum in ♀ triangular, apex subacute ; in ♂ quadrangular, apex obtuse-angled, hind angle rather bluntly produced. Profile of head from occipital angle to eye

concave, more so in ♂ than in ♀. Twenty-one to twenty-two pairs of legs. Anterior (inner) margin of "hand" of prehensile leg of ♂ with a deep notch, but in young specimens (6 mm. long) straight or slightly sinuous. Telson with the claws slightly asymmetrical in ♂; upper margin with numerous fine spiniform denticles.

Dimensions.—13×8·5 mm.

Colour.—Shell corneous with slight greenish tinge, animal pale ochreous.

Locality.—Ovamboland: Ukualuthi and Ukualonkathi (about 100 miles N.W. of Ondongua).

Type in South African Museum.

The large size and the shape of the head distinguishes this species from all the others of the genus.

Fam. LEPTESTHERIIDAE.

Limnadiidae (part) and *Estheriidae* (part) auctorum.

1910.	*Cyzicidae* (part).	Stebbing, Ann. S. Afr. Mus., vi, p. 486.
1913.	*Leptestheriidae.*	Daday, Math. Termt. Ert., xxxi, pp. 566, 579.
1915.	,,	*Id.*, Ann. Sci. Nat., ser. 9, vol. xx, p. 48.
1923.	,,	*Id.*, *ibid.*, ser. 10, vol. vi, p. 255 (revision).

Shell pellucid (but often rendered opaque with extraneous matter), laterally compressed, ovate-oblong, with numerous and distinct growth-lines, and more or less distinct surface sculpturing. Head without frontal appendage, with distinct fornix on each side extending to apex of rostrum. Rostrum armed with a distinct apical spine in both sexes. Eyes contiguous. First antenna long, with numerous lobes on anterior margin bearing sensory setae. Second antenna strong. Twenty-two to thirty-two pairs of legs; 1st and 2nd pairs in ♂ prehensile; exopod (Sars) or dorsal lobe of epipod (Daday) of 9th pair in ♀ filiform; on the 10th–11th, 10th–12th, 10th–13th, 10th–14th, or 10th–15th pairs this lobe is cylindrical, ovigerous. A triangular epipodal lamina present on some of the anterior pairs of legs in both sexes. Caudal furca claw-like. Foremost tooth on upper margin of telson not large or stronger than the following ones.

Europe, Asia, North and Central America, Africa.

The chief reasons for the institution of this family are the presence of the triangular epipodal lamina on the legs, and the presence of the

spine at the apex of rostrum. The first character is certainly distinctive, but the second loses much of its value from the fact that a similar and evidently homologous spine occurs in at least two of the species of *Caenestheriella*, viz. *australis* and *crinita*.

In *Caenestheriella* it is present only in the young, and if it persists at all, it is only in a reduced or vestigial state. In the members of this family it is much stronger and always persists in both sexes.

Daday mentions three other distinguishing features of this family (*loc. cit.*, p. 257): the development of the cylindrical process on two or more of the 10th–15th pairs of legs in ♀ to support the egg-mass, the character of the spines on the margin of telson, and the shape of the shell. These three characters, with the exception perhaps of the first, seem scarcely of sufficient importance for family distinctions.

The enlargement of the foremost tooth or spine on the upper margin of the telson in the *Cyzicidae* is a useful " first aid " in identification ; in the present family the foremost tooth or spine is not larger than the others.

Key to the South African genera.

1. Margin of the exopods (branchial epipods) of legs entire . . *Leptestheria.*
2. Margin of the exopods with digitate, setiferous processes . . *Leptestheriella.*

Gen. Leptestheria Sars.

1898.	*Leptestheria.*	Sars, Arch. Naturv. Krist., xx, No. 6, p. 9.
1900.	,,	*Id., ibid.*, xx, No. 9, p. 10.
1910.	,,	Stebbing, Ann. S. Afr. Mus., vi, p. 488.
1913.	,,	Daday, Math. Termt. Ert., xxxi, p. 580 (in Hungarian).
1923.	,,	*Id.*, Ann. Sci. Nat., ser. 10, vol. vi, p. 276.

Head with occipital angle acutely produced ; rostrum often broader in ♂ than in ♀, but usually not differing greatly in the two sexes. Twenty-two to twenty-six pairs of legs ; margin of the exopod (or branchial epipod as Daday calls it) entire ; dorsal lobe of exopod cylindrical on two or more of the 10th–15th pairs of legs in ♀.

Key to the South African species.

1. Shell-sculpturing reticulate or areolate.
   a. Occipital angle of head moderately produced . . . *rubidgei.*
   b. Occipital angle considerably produced. Rostrum very short *brevirostris.*
2. Shell-sculpturing striate . . . . . *striatoconcha.*

Leptestheria rubidgei (Baird).

(Text-fig. 32, *a–f*.)

1862. *Estheria rubidgei.* Baird, Proc. Zool. Soc. Lond., p. 148, pl. xv, figs. 3–3*b*.
1862. ,, *macgillivrayi.* *Id.*, *ibid.*, p. 148, pl. xv, figs. 5–5*b*.
1898. *Leptestheria siliqua.* Sars, Arch. Naturv. Krist., xx, No. 6, p. 11, pls. ii, iii.
1899. ,, ,, *Id.*, *ibid.*, xxi, No. 4, p. 23, pl. iii.
1910. ,, ,, Stebbing, Ann. S. Afr. Mus., vi, p. 488.
1923. ,, *braueri.* Daday, Ann. Sci. Nat., ser. 10, vol. vi, p. 280, fig. 84 (juv.).
1923. ,, *gigantea.* *Id.*, *ibid.*, p. 284, fig. 85.
1923. ,, *siliqua.* *Id.*, *ibid.*, p. 300, fig. 90.
1923. ,, *macgillivrayi* and *rubidgei.* *Id.*, *ibid.*, pp. 350, 351, figs. 103, 104 (" species insufficienter cognitae ").

Shell ovate or ovate-oblong, deeper anteriorly, dorsal margin straight, forming a distinct angle with the hind margin, growth-lines numerous but not prominent, finely setulose, more so in young than in adult; sculpturing consisting of closely aggregated depressions of varying shape and size, the intervening raised borders of the depressions forming a reticulate or areolate pattern, which is larger and more areolate on the younger portions of the shell, smaller and more regularly reticulate towards the margins in adult shells. Rostrum in ♂ sometimes narrower, sometimes broader, apically rounded or sometimes subquadrate; in ♀ subtriangular, apically subacute. Occipital angle shortly produced. Profile between occipital angle and eye convex, concave, or sinuate. Segments 26–28, of which 23–24 are pedigerous, the posterior 2–3 segments often apodous. Anterior (inner) margin of " hand " of prehensile leg of ♂ with a moderate, or a deep, notch in adult; nearly straight in young. Tenth and eleventh pairs of legs in ♀ with cylindrical dorsal lobe of exopod. Spines and setae on posterior segments very variable, often much stronger than shown in Sars' figures, the hindermost 2–4 segments often without any armature at all. Spines on upper margin of telson numerous, subequal, closely set.

Dimensions.—Up to 12×7 mm.

Colour.—Shell corneous, animal pale yellowish or ochreous.

Locality. Cape Province : Cape Town (Sars) ; Port Elizabeth (Sars, Daday) ; Hanover (Sars) ; Bushmanland=Little Namaqualand (Sars) ; Grahamstown (Albany Mus. and Natal Mus.) ; Cape Flats ; Prinskraal, Bredasdorp Div. ; Pofadder, Kenhardt Div. ; Upington ; Beaufort West Division ; Pocaltsdorp ; Gouritz River railway bridge.
Basutoland : Morajia.
Bechuanaland : Kalahari (Daday : *braueri*).
Transvaal : Rietfontein ; Heidelberg.

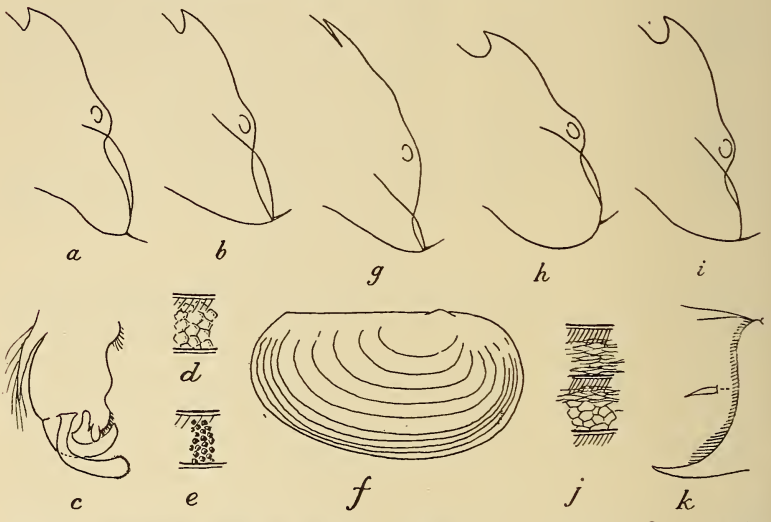

Fig. 32.—*Leptestheria rubidgei* (Baird): *a*, Head of ♂ ; *b*, head of ♀ ; *c*, 1st leg of ♂ ; *d*, *e*, sculpture of shell, young and old portions respectively ; *f*, shell. *L. brevirostris* Brnrd. : *g*, Head of ♀. *L. striatoconcha* Brnrd. : *h*, Head of ♂ ; *i*, head of ♀ ; *j*, sculpture of shell ; *k*, telson.

Distribution.—Daday believed that the specimens from Russia and Transcaucasia, referred by Zograff to this species (1907, Zeit. wiss. Zool., lxxxvi, p. 449), were more likely to be *rotundirostris*. Thiele's record of *siliqua* from the Massai Nyika (1900, Zool. Jahrb. Abt. Syst., xiii, p. 571) is referred to by Daday in 1913 (Voy. Alluaud Afr. orient. Phyllop., p. 3) and again in his revision (1923, *loc. cit.*, p. 304). In the latter work, however, he describes (*loc. cit.*, pp. 370, 375) some specimens from the identical locality as *Leptestheriella thielei*. One has to assume therefore that the material collected by Neumann and recorded by Thiele contained two species, and that *siliqua* (*rubidgei*) occurs also in the East African region.

Types of *rubidgei* and *macgillivrayi* in British Museum, of *siliqua* in South African Museum, of *braueri* in Berlin Museum, of *gigantea* in Vienna Museum.

There can be no reasonable doubt that *siliqua*, recorded from Cape Town and Port Elizabeth, is synonymous with *rubidgei* and *macgillivrayi* from the same two localities. At the time Sars wrote it might have been urged that our knowledge of the South African Conchostraca and their distribution was not far enough advanced to exclude the possibility of two species (of similar shell characters) being found in the same locality. To-day our knowledge is by no means so far advanced as to be conclusive. But since in these two localities, especially Cape Town and its environs, no species resembling Baird's two species, except *siliqua*, has been reported, the conclusion seems justified that *siliqua* is, in fact, the same as Baird's species. As *rubidgei* has line and figure precedence over *macgillivrayi*, the former name should be used.

This species is a variable one, as can be seen from the diagnosis. In the specimens from Rietfontein the rostrum is especially broad, apically rounded, or even subquadrate, thus resembling some forms of the equally variable *dahalacensis*. Further, I have seen one ♀ from Heidelberg (Transvaal), with a perfectly oval outline to the shell, without any angle between the dorsal and hind margins.

Leptestheria brevirostris Brnrd.

(Text-fig. 32, *g*.)

1924. *Leptestheria brevirostris*. Barnard, Ann. S. Afr. Mus., xx, p. 227, pl. xxvi, fig. 18.

Shell similar in form and sculpturing to that of *rubidgei*. Rostrum (♀) very short, apically acute ; occipital angle strongly and acutely produced. Twenty-three pedigerous segments. Tenth and eleventh pairs of legs in ♀ with cylindrical ovigerous exopods. Spines on upper margin of telson subequal, rather widely spaced. Dorsal surface of last 3 or 4 segments minutely granulate as well as setiferous.

Dimensions.—4·5 × 2·5 mm.

Colour.—Pale corneous.

Locality.—Damaraland : Waterberg, E. of Otjiwarongo.

Type in South African Museum.

Founded on an ovigerous ♀ and a young ♀ ; distinguished from *rubidgei* by the produced occipital angle and the short rostrum.

Leptestheria striatoconcha Brnrd.

(Text-fig. 32, *h–k*.)

1924. *Leptestheria striatoconcha.* Barnard, Ann. S. Afr. Mus., xx, p. 227, pl. xxvi, fig. 19.

Shell ovate or ovate-oblong, deeper anteriorly, dorsal margin forming a distinct angle with posterior margin, growth-lines numerous, setulose, especially in young ; sculpturing consisting of raised subcontinuous striae enclosing elongate fusiform depressions, striae longitudinal anteriorly and in the middle, becoming transverse posteriorly ; on the outer margin the striae tend to form an irregular reticulation, the depressions becoming more or less polygonal. Rostrum in ♂ stout, broadly rounded apically ; in ♀ narrower, apically subacute. Occipital angle shortly produced. Twenty-two to twenty-three pairs of legs. Anterior (inner) margin of " hand " of prehensile leg of ♂ deeply notched. Tenth and eleventh pairs in ♀ with cylindrical dorsal lobes of exopods. Upper margin of telson with numerous closely set spines, subequal proximally, but becoming long distally at the base of the apical claw.

Dimensions.—Up to 9 × 6 mm.

Colour.—Shell corneous, animal pale yellowish, ova salmon-coloured.

Locality.—Ovamboland : widely distributed (Barnard).

Transvaal : Heidelberg.

Type in South African Museum.

This species is very closely allied to the Northern African *mayeti* Simon ; in fact, the only real difference seems to be in the spines on the upper margin of telson, which are all nearly uniform in size in *mayeti*. The absence of spines or setae from the posterior 3–7 segments in *mayeti* may prove to be an inconstant character as it is in *rubidgei*.

There are two other North African forms with striate shell-sculpturing : *cortieri* Daday and *aegyptiaca* Daday. They differ in having the 10th–13th and 10th–14th pairs of legs respectively with cylindrical ovigerous exopods in ♀.

Gen. Leptestheriella Daday.

1913. *Leptestheriella.* Daday, Math. Termt. Ert., xxxi, pp. 579, 583 (key to species in Hungarian).

1923. ,, *Id.*, Ann. Sci. Nat., ser. 10, vol. vi, p. 352.

Head with occipital angle acutely produced ; rostrum often broader in ♂ than in ♀. Twenty-two to thirty-two pairs of legs. Margins

of exopods of the legs with lobate or digitiform processes. Dorsal lobe of exopod in ♀ cylindrical on 10th and 11th pairs of legs.

Key to the South African species.

1. A strong tooth on ventral surface of telson . . . . . *calcarata.*
2. No tooth on ventral surface of telson . . . . . *inermis.*

Leptestheriella calcarata Daday.

(Text-fig. 33, *a–d.*)

1923. *Leptestheriella calcarata.* Daday, *loc. cit.*, p. 366, fig. 108.
1924. *Leptestheria rubidgei.* Barnard, Ann. S. Afr. Mus., xx, p. 227 (non Baird).

Shell ovate or ovate-oblong, dorsal margin straight, forming an angle with hind margin, growth-lines setulose ; sculpturing areolate

Fig. 33.—*Leptestheriella calcarata* Daday: *a*, Head of ♂ ; *b*, head of ♀ ; *c*, telson ; *d*, 3rd leg of ♂. *L. inermis* n. sp.: *e*, Head of ♂ ; *f*, head of ♀ ; *g*, telson of ♀ ; *h*, 3rd leg of ♂.

with irregular polygonal depressions. Rostrum in ♂ narrowly rounded apically, in ♀ rather broader, apically subquadrate. Occipital angle shortly produced. Twenty-two (♀) to twenty-four (♂) pairs of legs. Anterior (inner) margin of " hand " of prehensile leg of ♂ notched. Margin of exopods with rather long, often bifid, digitiform processes.

Cylindrical exopods of 10th and 11th pairs of legs in ♀ slender. Segments with dorsal armature of spines and setae. Telson with a strong tooth on ventral surface in both sexes, spines on upper margin subequal, smooth.

Dimensions.—Up to 7×4·5 mm.

Colour.—Pale castaneous or whitish.

Locality.—Bechuanaland : Kalahari (Daday).

Great Namaqualand : Great Fish River near Gibeon.

Type in Berlin Museum.

This species is at once distinguished from all the other South African Leptestheriids by the telsonic tooth.

Leptestheriella inermis n. sp.

(Text-fig. 33, *e–h.*)

Shell similar to that of *calcarata*, but the sculpturing not so coarse. Rostrum in ♂ broadly rounded, in ♀ subquadrate. Occipital angle strongly produced. Twenty pairs of legs. Anterior (inner) margin of "hand" of prehensile leg of ♂ notched. Margins of exopods with short lobe-like processes. Cylindrical exopods on 10th and 11th legs in ♀ very stout. Segments without any dorsal armature of spines or setae in both sexes ; posterior 6–7 segments in ♀ raised up into a cockscomb-like ridge. Telson without ventral tooth ; upper margin in ♀ minutely crenulate, with a few setae distally, in ♂ perfectly smooth, or with one or two minute denticles proximally.

Dimensions.—5×3 mm.

Colour.—Shell pale corneous.

Locality.—Cape Province : between Upington and Keimoes.

Type in South African Museum.

This species is well distinguished from all the others by the absence of armature on the dorsal margins of the segments, and its great reduction on the upper margin of telson, especially in the ♂.

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